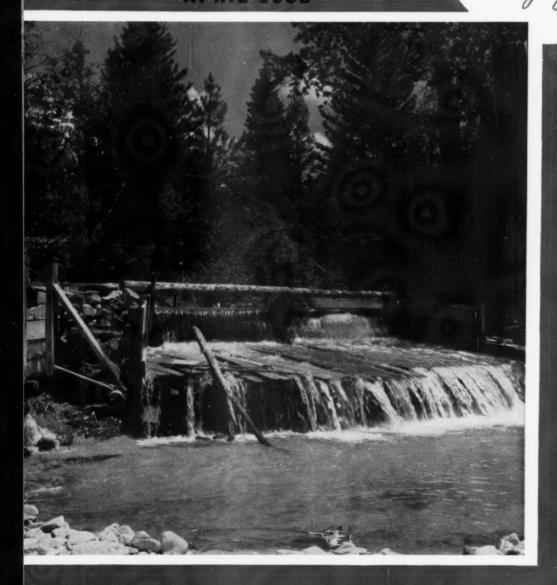
Compressed Air Magazine APRIL 1958

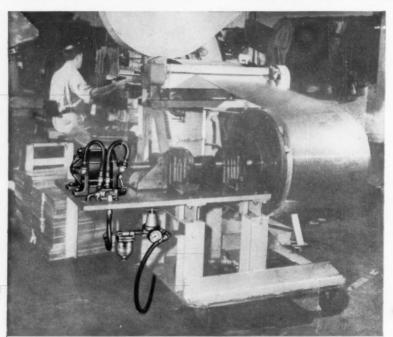


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VOLUME 63 • NUMBER 4

NEW YORK . LONDON

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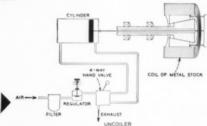
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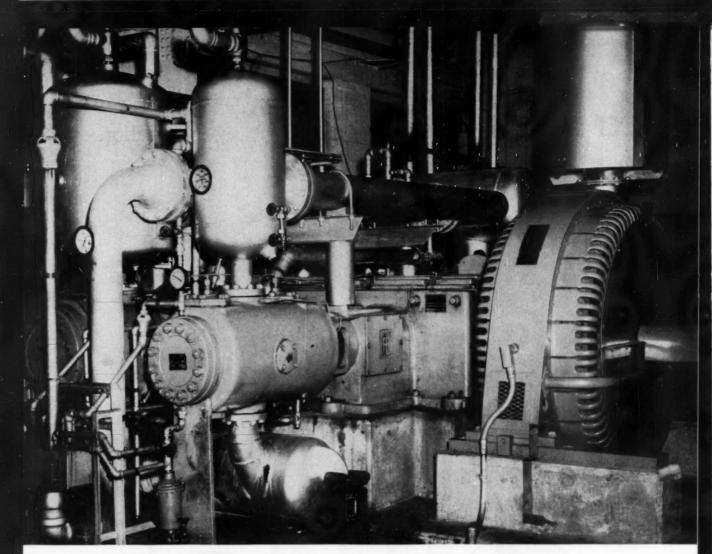
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Compressed Air Magazine

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NEW MEXICO STATE TOURIST BUREAU

ON THE COVER

CHOWING one of the more pleasant and, perhaps, nostalgic views of the nation's water supply network, our cover picture this month is of a small dam thrown across a mountain stream in northern New Mexico. Water is diverted by the structure to the uses of a molybdenum mine not far away. Water itself is one of the most important of the nation's natural resources and without adequate supplies of it, all industry, from mines to steel plants and chemical manufactories would be out of business. Our editorial this month discusses some aspects of water supply.

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April 1958

FEATURE ARTICLES

Page 12 Two Centuries Of Mining-C. H. Vivian

A lead-zinc deposit in Virginia has been mined almost continuously since its discovery in 1756. A recent expansion program has made the 2-century-old mine one of The New Jersey Zinc Company's primary

18 Gas Storage Venture-S. M. Parkhill

Laclede Gas Company, a 101-year-old St. Louis utility, is pumping natural gas into an underground formation that never held gas before in an effort to expand its service to its customers. With the chill of this year's severe winter barely gone, Laclede and its 370,000 customers can settle back, knowing that the venture has proved successful.

22 America's Great Slumbering Fleet-J. A. McCormick

The U.S. Navy's mothball fleet may prove to be of incalculable value to America's future economy and preparedness. Readying the ships of the fleet for peacetime slumbers is one of the largest preventive maintenance programs extant.

26 Reservoir Protection

Another phase of this country's battle against water waste is being waged by the Bureau of Reclamation. The weapon in use—an evaporation-preventing film.

28 Shaft Sinking Record

Stanrock Uranium Mines Limited is pushing to completion a 3000foot-deep development shaft.

Testing Structures With Sound

By generating high-frequency vibrations with compressed air, Boeing tests aircraft parts.

30 Dime-Sized Power Plant

Tiny high-voltage dry cells are being made with wax electrolytes.

Alcoa Goes To Surinam

New aluminum refining facilities are slated for the Guianas.

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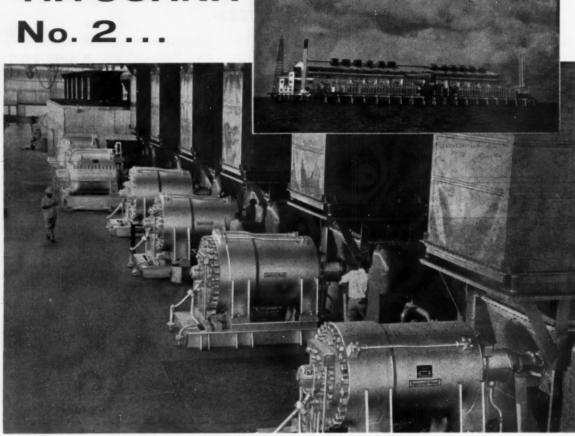
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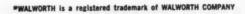
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The 12½-ft-diameter tunnel is being built for the Commonwealth of Massachusetts, Metropolitan District Commission, Construction Division, by Coker Construction Co. The tunnel is about 300 ft below ground level, and at its extremities, connects two vertical shafts. Upon completion, it will divert Spot Pond Brook through an inverted siphon beneath the city.

Bethlehem Hollow Drill Steel keeps costs down in all kinds of rock removal because it stays on the job. Rolled from fatigue-resistant steel, it has a uniform hole which is centrally located in the bar. Bethlehem Hollow has a wide quenching range. And it is easy to heat-treat for the proper balance of toughness and wear-resistance, providing longwearing threads and strong shanks.

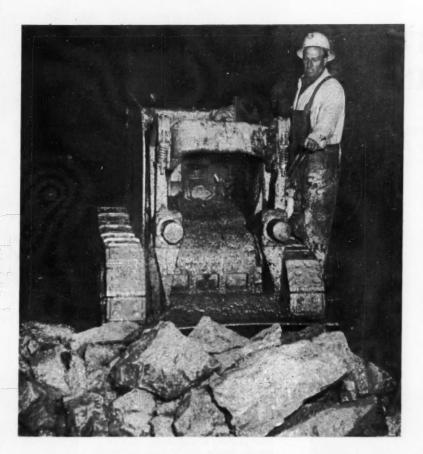
Bethlehem Hollow can be obtained in Carbon and Ultra-Alloy grades in rounds, hexagons and quarter-octagons. It comes regularly in lengths of from 18 ft to 27 ft, though longer lengths can also be furnished. Specify Bethlehem Hollow the next time you need drill steel.

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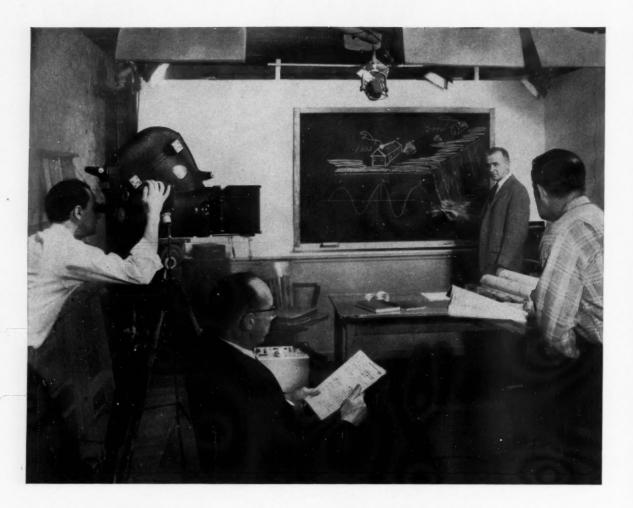




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TWO CENTURIES OF MINING

Having furnished lead to colonists and soldiers of two wars, The New Jersey Zinc Company's deposits at Austinville, Va., are now yielding zinc

C. H. VIVIAN



OLD SHOT TOWER

Erected around 1822, this tower, on a high bank of the New River, was used for making shot by dividing molten lead into globules that fell 140 feet into a pit at the bottom of a shaft below containing seepage water from the stream. Its use was discontinued in 1851 when a drop of 241 feet was arranged at the mine shaft. To preserve the tower, the local Ruritan Club, one fifth of whose membership is farmers, bought an acre of ground that includes it. A marker was erected there by the D.A.R.

HE New Jersey Zinc Company's mine at Austinville, Va., has passed its 200th year. Other American mines were in production earlier, but none has operated so long, virtually continuously. For the first 114 years, the mine produced lead exclusively, and bullets made from its ores wrote history in colonial sorties against marauding Indians and during the Revolutionary and Civil wars. Since then,

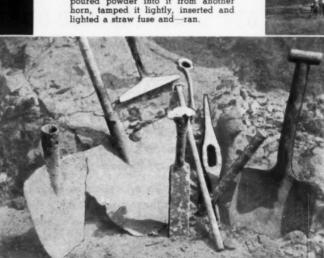
zinc has become the leading product, with lead of secondary importance. Finding a way to extract zinc from the deep sulphide ore presented a stubborn metallurgical problem that, before it was solved in the 1920's, almost closed the mine.

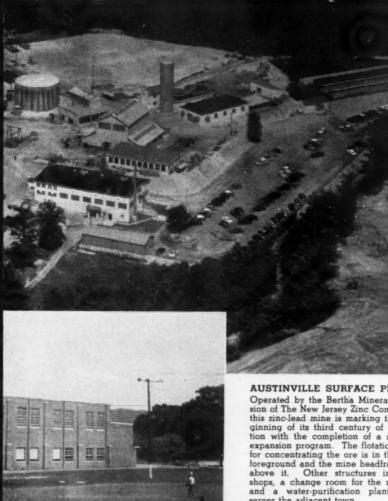
During the past 10 years, an entirely new mine has been developed in the nearby Ivanhoe section. It has been consolidated with the Austinville operation by means of a 2½-mile connecting tunnel. Production facilities of the Austinville Mine proper have also been improved and increased by the sinking of a new service shaft. It is 1½ miles from the Van Mater shaft, through which all ore is hoisted. The Austinville district has been, and remains, Virginia's only zinc-producing area of commercial importance.

John Chiswell, a Welsh colonial ad-



A collection of tools (below) from the era of hand mining methods. Blast holes were drilled with hammers and chisels, and shot with black powder, a tricky explosive to handle. After drilling a hole, the miner used a waterfilled cowhorn to wash it out. Next he poured powder into it from another horn, tamped it lightly, inserted and lighted a straw fuse and—ran.





AUSTINVILLE SCHOOL

Austinville, a community of some 150 families, has a modern central watersupply system, sewage disposal plant and other conveniences. Pictured are the commodious school building and adjacent playground. The building contains bowling alleys and other recreational facilities for the use of young

venturer, discovered the deposits in 1756 while hiding from pursuing Indians in a cave in the New River area of what is now southwestern Virginia. Having some knowledge of mineralogy, he spent the time examining the rocks in the cavern and found some pieces of lead ore. Later, having located mineralized outcrops in the vicinity, he applied to the colony for a grant of land surrounding the discovery location and formed a partnership with his son-in-law, John Robinson, and Col. William Bird III, in order to finance mining operations. They began digging out lead carbonate ore that was either exposed or lying under shallow overburden. Some of it reportAUSTINVILLE SURFACE PLANT

Operated by the Bertha Mineral Division of The New Jersey Zinc Company, this zinc-lead mine is marking the beginning of its third century of operation with the completion of a sizable expansion program. The flotation mill for concentrating the ore is in the left foreground and the mine headframe is Other structures include shops, a change room for the miners and a water-purification plant that serves the adjacent town.

edly contained as much as 60-percent A small smelting furnace was erected and soon pack trains were carrying the metal product to outlying settlements and eastern markets.

Chiswell prospered and maintained a home in Williamsburg, capital of the colony, but came to a tragic end as the result of a barroom fight at Cumberland Courthouse on a June evening in 1776. Angered when allegedly chided by a friend, John Routlidge, over his boasts about the lead mine, Chiswell called for his sword and fatally wounded the unarmed Routlidge. He was arrested and charged with murder but released on bail. While awaiting trial. he died suddenly in his home. Although the cause was formally announced as "nervous fits," it was generally believed that he had hanged himself.

The mining property, known as Chiswell's Mine and Lead Mines, grew in importance because it was the only substantial source of lead in the American territory that was under British control. Frontiersmen relied on it for balls for their long "Kentucky" rifles, and its growing stature was recognized in 1772 when the governor, Lord Dunmore, made Lead Mines the seat of govern-

ment of vast Fincastle County. Had it not been for the Chiswell venture, it has been asserted, the settlement of the Ohio River valley and the section southward beyond the mountains might have been delayed many years.

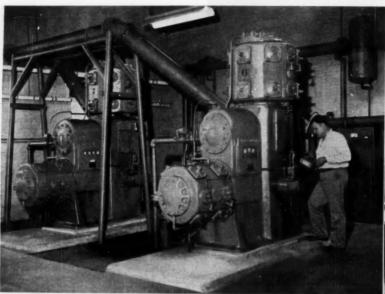
Settlers angered by Indian forays gathered at Lead Mines to fill their bullet pouches before setting out in pursuit. One party, led by Gen. Andrew Lewis, crushed an Indian band under the famed chieftain, Cornstalk, at Point Pleasant, W. Va., in the summer of 1774. Of this battle, Theodore Roosevelt wrote in Winning of the West: ". . . Its results were most important. It kept the northwest tribes quiet for the first three years of the Revolutionary War; and above all it rendered possible the settlement of Kentucky and therefore the winning of the West. . . .

Four years after it was formed, Fincastle County was divided into three new counties: Montgomery (including Lead Mines); Washington; and Kentucky, which later became a state. Fort Chiswell, a few miles from Lead Mines, was made the Montgomery County seat. Before the original county was dismembered, it gave its name to the Fincastle Resolutions of Liberty, the first Colonial declaration of independence in which the signers pledged their lives in defense of liberty and which set the stage for

Austinville Lead Turned Revolutionary War Tide

American colonists depended heavily on lead. It gave them bullets with which to procure fresh meat from forest game and to protect themselves against Indians and predatory wild animals. It also gave them buttons for their clothing. Lead that was mined at Austinville, Va., expedited the settlement of a vast area in and south of the Ohio River valley. Some historians have asserted that the Revolutionary War might have ended differently without it. During the Civil War, 1200 tons of it was shipped to Confederate arsenals.

Although zinc was present in the ore from the start, it was not recognized until around 1870 and did not become commercially important until the selective flotation process provided the means of extracting the metal. The New Jersey Zinc Company acquired the Austinville property in 1902 and has since developed it into one of its leading operations.



the momentous action of July 4, 1776. They were drawn up by the freeholders of the county at Lead Mines in January 1755, and were addressed to the Virginia delegates to the Continental Congress.

Thomas Jefferson, then governor of Virginia, called the mines "of great importance" as a source of lead during the war and said, "we think it impossible that they can be worked to too great an extent." After the fighting ceased, Virginia took over the mines and operated them until 1780, with troops stationed at Fort Chiswell protecting them against Indians and Tories. The latter, of whom there was a sizable local group, tried, on various occasions, to stir up trouble. In the quelling of an uprising in 1780, several hangings took place. Charles Lynch, manager of the mines and also a justice of the peace, headed his miners as they aided Col. William Campbell and his soldiers in restoring order. He is said to have employed extralegal measures of trial and punishment that gave our language the term "lynching." He was indemnified for his action by an act of the Virginia Assembly in 1782.

Moses Austin, a merchant from Philadelphia, Pa., bought the mines from the state at auction. He stipulated that a post office should be established there, and thus the name of Austinville originated, sometime between 1780 and 1790. Austin sank exploration shafts up to 150 feet deep, improved the efficiency of the furnaces and imported technical workers

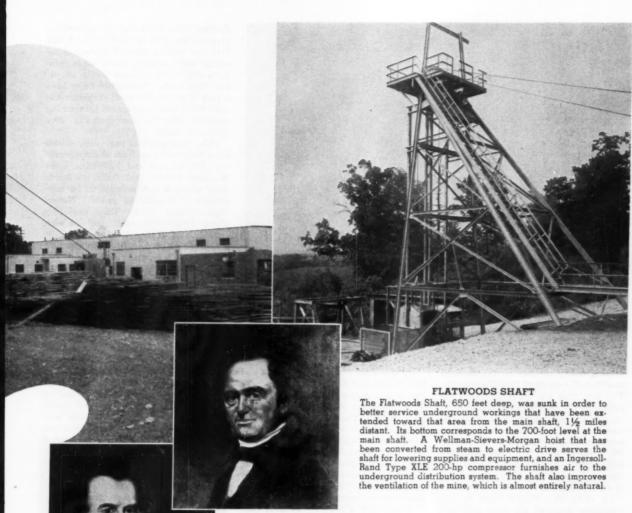


VIEWS AT IVANHOE

A new shaft has been sunk to open up additional mining ground and a $2\frac{1}{2}$ -mile tunnel driven from its bottom to Austinville for transporting ore underground for hoisting and milling there. The hoist (bottom, center) that serves the Ivanhoe Shaft and two Ingersoll-Rand Type XLE compressors installed there are shown. Principal underground uses of compressed air are operating rock drills, diamond drills, gates on ore chutes and loading pockets and hoists that power scraper loaders.

from Philadelphia and even from England. In 1796, he leased the property to Capt. James Newell and left for the supposedly richer lead deposits of Kansas and Missouri, taking his wife and baby son. The latter, Stephen Fuller Austin, was destined to give his name to the capital of Texas, after having founded the principal English-speaking settlements in the state during the 1820's, while the country was at war with Mexico.

Captain Newell ran the mine until 1805, when it was learned that Austin had not paid the full amount due under his contract. The state took the property back, put it up for sale again and Thomas Jackson, Newell's neighbor, acquired it on a bid of \$19,000. Accounts of the next few years are confusing. Daniel Sheffey and David Pierce apparently shared the ownership part of the time, but Jackson was in charge just prior to his death in 1824.



THE AUSTINS—FATHER AND SON

Moses Austin, above (from an oil painting owned by the Missouri Historical Society), ran the mine after the Civil War ended and gave the community its name. He left for the Missouri lead fields in 1796, taking with him his wife and infant son. The latter, Stephen Fuller Austin, is hailed as the founder of the State of Texas, where the capital city is named for him. The picture is a photo-copy of a portrait that hangs in the Senate Chamber of the Texas State House.

For making shot by the drop method that originated in England, Jackson built a stone tower. Molten lead was hoisted to its top and poured through a sieve-like vessel to divide it. The globules became spherical as they fell and solidified when they struck water in a shaft at the base of the tower, 140 feet below.

Old ledgers show that miners of the period received from \$20 to \$25 a month and bought eggs for 3 cents a dozen and coffee at 5 pounds for a dollar at the commissary. Some of the names listed are still found in the community and

on current payrolls—among them Hudson, Stoot, Pearman, Alley and Freeman.

The Wythe Lead Mines, organized in 1838, was the first company owner and operator of the property. As the workings were then deep enough for water to accumulate, they were tapped by a drainage adit driven from the riverside. Ventilation shafts were sunk to carry off gases that had previously bothered the miners. For the first time, mining was carried on the year-round and miners began using candles underground instead of tallow lamps. Pig lead and

shot were hauled by wagon to Baltimore, Md., and elsewhere. The drivers might be gone for months on these "adventures," as the old ledgers called them.

A reorganization, in 1848, created the Wythe Union Lead Mine Company, which later dropped the first word of its name and operated the property during the Civil War. Realizing that Austinville was its chief source of lead east of the Mississippi River, the South put it under guard, and the entire output was consigned to southern arsenals. Despite shortages of iron and drill steel, more than 2000 tons of lead was contributed to the Confederate war chest, although output had previously been only about 300 tons a year. Union forces tried repeatedly to interrupt operations, but didn't succeed until near the end of the conflict-too late to have any effect.

During this period, a chemist at Petersburg, Va., who had tested some ore sent to him for experimental purposes, recognized zinc in it. This identification probably kept the mine from closing, as lead from the rich deposits of Wisconsin, Kansas and Missouri was



UNDERGROUND SCENE

Much of the ore broken in the stopes is moved to chutes by scrapers powered by hoists. This view shows an Ingersoll-Rand 15-hp, 3-drum hoist and its operator.

making heavy inroads on the markets traditionally supplied from Austinville. The zinc, that had previously been discarded in the tailings from the lead recovery process, was now in some de-Representatives of eastern mand smelters visited Austinville to buy up the waste at \$10 a ton. Meanwhile the mine operators continued to save only the lead because they were not equipped to recover the zinc.

In 1874, the Wythe Lead & Zinc Company acquired the mine and took steps to process the zinc. A spur of the Norfolk & Western Railroad reached Austinville from Pulaski, Va., in 1887. A smelter with a 400-ton daily capacity was put in service in 1888. However, other interests had opened up a new rich mine, the Bertha, 6 miles to the northeast, and built a larger smelter at Pulaski. In 1898, the Austinville smelter was shut down, and during the next 4 years, the mine sold all of its ore to the Bertha Mineral Company.

The New Jersey Zinc Company, which had become aware of the high-quality slab zinc being made at the Bertha smelter, purchased the Bertha holdings in 1901 and the Austinville property a year later. It was seeking a reserve of soft zinc carbonate ore, but it turned out that this had been largely exhausted with increased depth and only the harder zinc sulphide, sphalerite, was present in abundance. Consequently, a process had to be worked out for concentrating it. Meanwhile, a zinc oxide furnace was built at Austinville to recover the zinc left in the accumulated tailings, and it operated until the supply was exhausted in 1911.

By this time, the Bertha deposits had been depleted as were the soft, carbonate zinc ores at Austinville, but still no way of reducing the hard sulphide ore had been found. The Pulaski smelter was dismantled and sold and the Bertha Mine closed. Austinville escaped a like fate only because it was determined, after several years of experimentation, that the sphalerite could be satisfactorily concentrated by the then comparatively new flotation process.

A mill with a capacity to treat 1000 tons of ore a day was built in 1925, and the Van Mater 5-compartment vertical shaft that is still in service was sunk. Since then, the Austinville enterprise has grown steadily into one of the leading operations of the parent company. The mill capacity has been increased to approximately 3000 tons a day.

The most important phase of a current expansion program, now nearing completion and which will materially lengthen the productive life of the district, is the Ivanhoe development. It has involved sinking a 3-compartment shaft to a depth of 1050 feet, constructing surface structures, opening a new mining area and driving a 13,500-foot tunnel to the Van Mater shaft so that all ore can be hoisted there and treated in the nearby mill. In addition, a 650foot vertical shaft has been sunk at Flatwoods, 11/2 miles northeast of the Van Mater shaft. Supplies and equipment are lowered, and rock from development work in that area is hoisted. through it. It also aids in the ventilation of the mine, which is almost entirely natural.

The Ivanhoe development project was

decided upon following an exploration program initiated in 1947. New Jersey Zinc has always stressed geological research and currently has a large company-wide staff engaged solely in exploration work. Geologists have been a part of the regular staff at Austinville since 1927, and geochemical prospecting methods used by the company were pioneered there.

Other interests had previously mined some lead and zinc from shallow workings at Ivanhoe and had done some diamond drilling that failed to locate deep deposits rich enough to be considered of commercial grade. Nevertheless, New Jersey Zinc geologists thought further investigation was warranted, and drilling indicated a grade and tonnage of zinc-lead sulphide that justified underground development.

Ground was broken at the Ivanhoe shaft site in January 1952, full-scale operations were under way in April, and the job was completed a year later. Driving of the tunnel was undertaken from both ends in 1954 and completed in February 1957. It crosses under the New River where the stream is 400 feet wide, but this occasioned no difficulty. Three-man crews worked three shifts a day, 5 days a week. A 3-drill jumbo, mounting 31/2-inch drills was used on the Austinville end, and a 2-drill jumbo with 3-inch drills, on the Ivanhoe end. Other air-powered equipment that was of much assistance included mechanical shovels for loading muck, and spike drivers and tie tampers for laying and maintaining track. A permanent 6-inch air line and a 4-inch water line were installed as the headings advanced. Overall progress was at the rate of 12/3 linear feet of complete tunnel per man-shift. Surveying of the line entailed the plumbing of two shafts, for which special equipment was developed, and running 30,000 feet of traverses underground and on surface. It was done so accurately that a perfect connection was made.

The tunnel is 10 feet wide and 8 feet high and it slopes on a grade of 0.5 percent in favor of the load. Recesses cut at 200-foot intervals serve as safety stations for personnel when trains are running, and double tracking at several points permits trains to pass. The tunnel connects level 10 at the Ivanhoe shaft with level 11 at the Van Mater, the difference arising from a variation in the collar elevations of the two shafts. Plymouth 10-ton diesel locomotives will haul sixteen 4-ton cars of ore per train, and it is planned to transport as much as 1000 tons a day. The track, of 24inch gauge and 60-pound rails, is ballasted and tamped for a speed of 7-8 miles an hour, which is considered fast for underground haulage. All mining at the Ivanhoe end will be done above the tunnel level, thus permitting gravity

handling and loading.

The ore bodies occur as lenses in the Austinville dolomite, predominantly a light gray, massive crystalline rock and one of a series of lower Cambrian age. Above the Austinville formation is a very pure limestone that is called Carbide because it yields stone that is used in the area for making calcium carbide. At Austinville, the sedimentary series is folded into an anticline that is complicated by faulting. Almost all of the production comes from a block of ground between two large faults about 1200 feet apart. The ore bodies follow the dip of the enclosing strata, which is approximately 35 degrees. The principal minerals are the sulphides of zinc, lead and iron: sphalerite, galena and pyrite with occasional barite and quartz.

The mining method followed is described as underhand open stoping. Stope width varies with ground conditions and ranges from 30 to 100 feet. In most cases, pillars 30 feet thick are spaced on 100-foot centers, with stopes 70 feet wide between them. The ground is firm and little support is needed. Stopes are opened by raising two chute holes, normally spaced 35 feet apart, from drifts or haulageways driven under the ore bodies. Grizzlies are installed in chambers excavated at the footwall. After manway and service raises have been excavated (the latter in the center of the pillars) and crosscuts driven from



AIR POWER AT WORK

Nuts on bolts that hold the interior liner plates of rod-type ore-grinding mills in place formerly worked loose frequently after being tightened with a long-handled wrench. Use of the Ingersoll-Rand Size 577 Impactool shown has eliminated the trouble and also considerable hard labor.

them to provide access to adjacent stopes at either side, the chute raises are extended into the ore and enlarged into inverted, cone-shaped openings until they connect. From the point of connection, a spiraling bench is driven upward to the hanging wall that limits the ore body. A breast is then opened across the stope from pillar to pillar. and the underlying ore broken by benching. The broken ore is fed by gravity to the grizzlies and drawn off at the haulageway below. Ore that remains after a stope has been mined down beyond the gravity-flow point is moved to the grizzlies by slusher hoists. Some of the pillars are recovered later, and total ore extraction runs around 85 percent. Drilling in the stopes and most development headings is done with air-leg drills. Some drifting is carried on with 2- or 3-drill jumbos running on rails.

Ore passing through a grizzly is loaded from a chute into 4-ton cars, and a 12-car train is pulled by a storage-battery locomotive to the shaft, where the cars are dumped, by air-operated mechanisms, into an ore pass. The ore is then crushed to minus 4 inches and passed into a 500-ton storage pocket. From the pocket, it is automatically measured into 6-ton skips that are hoisted in balance.

Upon reaching the surface, the ore is belt-conveyed to the flotation mill. After being crushed and ground until 80 percent of it will pass through a 100mesh screen, it enters a 3-stage circuit of flotation cells where pine oil, xanthate and sodium cyanide reagents are added to attract lead particles, which are floated and skimmed off as froth. Copper sulphate is then added to the tailing, which passes to another 3-stage section where the zinc is extracted. After being filtered and dried, the zinc and lead concentrates are shipped to smelters for reduction to the metals. The mill utilizes mine water because its uniform temperature throughout the year is beneficial to the process.

During the development of the flotation process, it was found that the dolomitic limestone tailing from the mill is an excellent soil conditioner for agricultural purposes, and this has given rise to an interesting by-product business. The material is classified and the coarser fraction is marketed as agricultural limestone. Since 1925, more than 6½ million tons of it have been sold. The finer portions of the tailing are piped to a valley near the mill for disposal. Some waste rock obtained from mine development projects is also sold for use in construction work.

The numerous underground faults and fractures often contain water, and all openings made are preceded by drill holes and grouting is done wherever necessary. Information obtained by drilling from the surface has been in-



A WASTE PRODUCT THAT AIDS CROPS

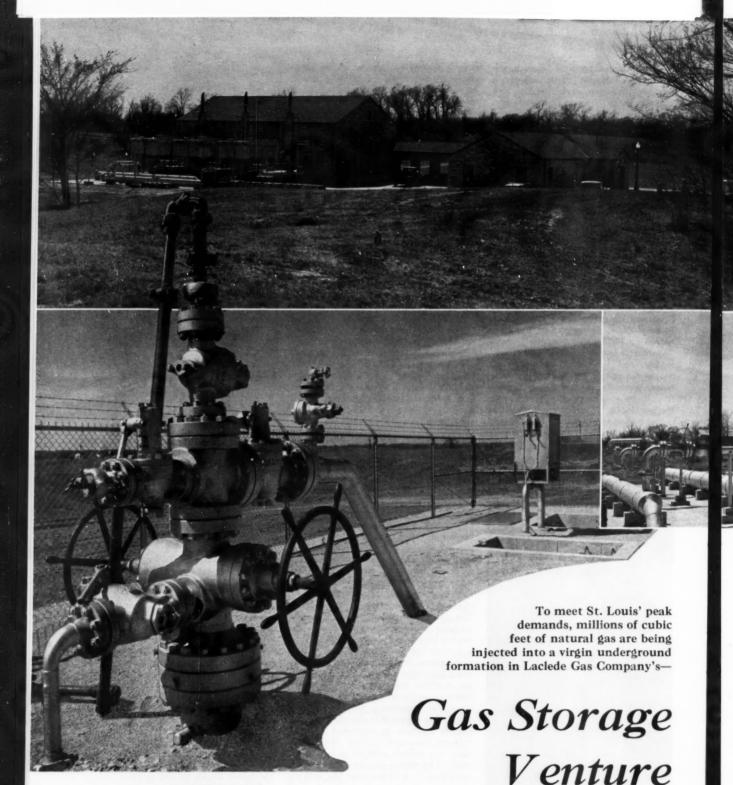
A bulldozer working on a pile of mill tailings that consists essentially of pulverized limestone. More than 6½ million tons of this material have been spread on mid-Atlantic farm lands, mainly in Virginia and North Carolina.

corporated in water-contour maps that indicate where hydrological problems are liable to be encountered. Steel doors throughout the mine can be closed to protect workings against heavy water inflows.

Between 5000 and 6000 gpm of water are pumped continuously from sumps at the Van Mater and Ivanhoe shafts, to which it flows by gravity. At the Van Mater it is lifted, in four stages, to the second level, and all of it that is not required for the mill operations is discharged through an adit to the New River. At the Ivanhoe, the water is pumped to the surface in two stages and run off into a branch of the river.

All pumping is controlled from stations located on level 7 at each shaft. A visitor to either of them sees a rather complex looking aggregation of breakers, starters, annunciator panels and switches. They automatically or manually control any pump in the shaft and show the water level in any sump and the power drawn by any pump.

It is possible to operate the pumps unattended, except for occasional surveillance of the annunciator panels and periodic maintenance checks of the pumping stations. At the Ivanhoe shaft, a remote annunciator panel and auxiliary control station near the hoist console provide for surveillance on weekends and holidays.

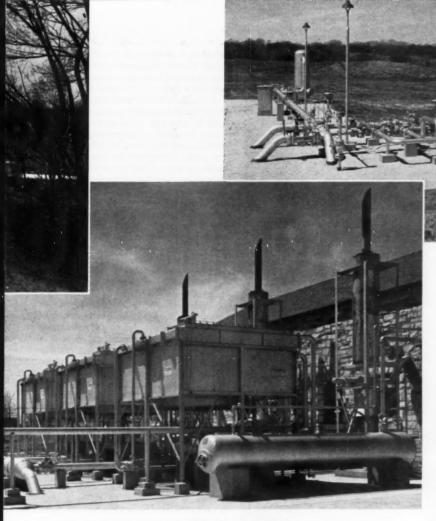


CHRISTMAS TREE

At each wellhead, there is a Cameron Christmas tree with hand-operated valves and a blowout preventer. Each is adapted with an orifice meter run and recorder so that the gas can be measured both on injection and withdrawal. A special cross-over line at the manifold is used for this purpose. Because of the existing pipeline system, gas can be fed to the city from both the Louisiana field and the storage area during peak demand periods, or to the field under normal conditions.

Venu

S. M. Parkhill



COMPRESSOR STATION

Housed in the attractive stone buildings, at the top (left), is Laclede Gas Company's storage compressor station. Within the one on the left, are three Ingersoll-Rand SVG engine compressors that are the main components of three J. B. Beaird Company packaged units. The close-up view (above) shows the three Young fancooled radiators, one being used for each gas engine group. Natural gas, engine cooling water and lubricating oil are all cooled in them. Silhouetted against the sky are three Maxim exhaust silencers, and in the right foreground is a Nooter starting-air tank.

CITY'S growth and progress can be measured in a variety of ways. LExpansion of its public utilities is, perhaps, one of the most indicative. A project started by Laclede Gas Company in 1951, for example, is a reflection of the growth of St. Louis, Mo. The utility is pumping natural gas underground where it is stored until needed to meet seasonal peak demands during the winter months. This method of solving high-demand problems is not new; other companies have done the same thing in spent gas fields. It is novel, however, in that Laclede is using a subterranean formation that never held gas before.

THE HISTORY of Laclede dates from March 2, 1857, when the company

was incorporated, whereas the story of gas in St. Louis precedes this date by 20 years with the formation of the St. Louis Gas Light Company in 1837. The latter was organized to improve street lighting and, by its existence, made St. Louis the seventh city in the United States to have a gas company. Four companies operated prior to 1889, at which date they were consolidated under the name of Laclede Gas Light Company. Its name was derived, in part, from that of Pierre LaClede Linquist, the eighteenth century founder of the city. The word "light" was deleted in 1950. The utility distributed coke oven and water gas, later supplementing it with natural gas supplied by Mississippi River Fuel Corporation through a line constructed in 1929.

Growth was slow until 1945. Origin-

GAS-FIRED HEATER

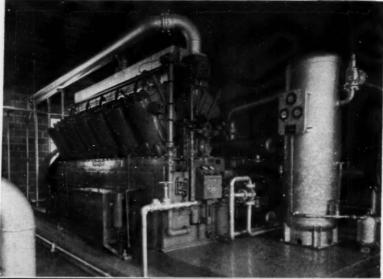
All gas, whether entering or leaving the storage area, must pass through the lines illustrated above. At the right is a Black, Sivalls & Bryson gas fired heater. Gas withdrawn from the area is reduced to a pressure of 150 psig and is passed through this heater to maintain a discharge temperature of 70°F. Included at this section is a Blaw-Knox gas cleaner, Nordstrom valves, Bristol recording meters and Fisher Governor Company pressure regulators.

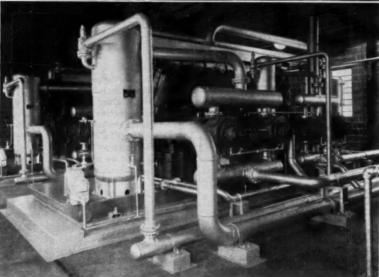
ally, Laclede was incorporated to serve only within the city limits. Since this area was established in 1876 when St. Louis was much smaller than it is today, it consisted of only 61 square miles.

Just after World War II the firm had decided on two steps. First was the expansion of its service area. This was done by the purchase, in February 1947, of St. Louis County Gas Company. Since the county served by that company included 497 square miles, the problem of territorial limitation was eliminated. Today, Laclede furnishes natural gas to customers in about 160 square miles of the county area, the balance being made up largely of rural sections.

The second step was the expansion of the base gas supply, which called for a conversion from mixed to straight natural gas. This was accomplished between May and December, 1949, extremely economically, when the conversion was made at a cost of only \$7 per customer.

Concurrently with the conversion, the gas supply was increased by the completion, in December 1949, of a second line from the Monroe field in Louisiana to St. Louis. This raised the incoming volume available to Laclede from 85 million to 268 million cubic feet per day. By 1951, Laclede was heating about 100,000 homes, and a like number wanted to convert to economical natural gas service. The obvious solution would have been to build more pipelines, but the cost of this would have been prohibitive in view of the fact that most of the additional gas would be used only





PACKAGED COMPRESSOR PLANTS

Engine-compressors, scrubbers, manifolds and coolers are part of J. B. Beaird Company's packaged compressor plant used at Laclede. Each is mounted on its own base plate. The Ingersoll-Rand units are 12-cylinder, V-type gas-engine compressors having four 2-stage horizontal compression cylinders. In the illustration at the top, the vertical tank on the right is a scrubber. The other picture shows the I-R units from the compressor side.

to meet seasonal peak loads. The construction of above-ground tanks would also have been too expensive, making the sales of future service to the average user impractical. Provided a suitable location could be discovered, storage of gas underground was thought to be the only practical solution.

Although there were no spent fields in the vicinity, there was a possibility, according to the Missouri Geological Survey, of a porous sandstone dome, ¼ mile below the surface of the ground and located only 18 miles north of St.

Louis. It was apparently sealed, gastight, at the top and bottom by shale, and the sandstone was filled with salt water. It was decided to investigate the formation by shallow well drilling, the program beginning in 1953.

This survey covered 25,000 acres and proved the existence of the structure sought. A deep test well was put down in July 1953, striking oil in the Trenton formation at 950 feet and providing further evidence that the structure was gas-tight. This well was sunk 3240 feet, penetrating the entire sedimentary

phase. A stratum of St. Peter sandstone, 100 feet thick, with good porosity and permeability, was found at 1450 feet.

Additional tests were conducted to verify the theory that the cap rock would hold in the gas. Differences between water pressure and between chemical constituents dissolved in the water in the wells drilled to the cap rock and those drilled to the sandstone proved that there was no communication between the two strata. With all facts indicating success, Laclede began leasing storage rights, guaranteeing that it would, in no way, affect surface use of the land. The Company further agreed not to use any mineral or potable-waterbearing strata. All necessary rights were secured by December 2, 1955.

HAVING finally solved the major problems, Laclede was ready for fullscale operation. Injection wells were drilled and a compressor station with a capacity of 16 million cubic feet per day was started in February 1955. Laclede began gas injection on December 2, 1955, a culminating step in what started as one of the biggest gambles ever taken by a gas company. The venture proved successful, however-1956 saw the addition of five more wells; and during 1957, four more were put down. By January 1958, 5 billion cubic feet had already been put into storage. Laclede estimates that there is room for about 45 billion

Gas is compressed to 625-psig pressure before it is pumped down the 1400-to 1500-foot wells into the dome. To boost the gas from its incoming pipeline pressure of approximately 100 psig, three Ingersoll-Rand 660-hp, 4-cycle SVG-12 gas-engine compressor units are utilized. Each has twelve power and four compressor cylinders. The latter are horizontal, consisting of two 10x12 first-stage cylinders and two 5½x12 second-stage ones.

The location north of the city is ideal. Natural gas comes to St. Louis from the south. All that was required to reach the storage field was to extend lines from the city's distribution mains northward to the compressor station. When customer demand is below pipeline capacity, gas flows to the storage area. When demand exceeds pipeline capacity, gas flows back from the field, and thus the city is fed from both north and south.

Gas, prior to being compressed, passes through a scrubber, then a measuring orifice and a Bristol recording meter to a 24-inch intake manifold. An 8-inch line carries it from the manifold through another scrubber to the first-stage cylinders of each compressor. Between stages, the gas is cooled in a fan-type radiator and passed through another scrubber. The second-stage discharge

makes another pass through the cooler, and then flows through a 6-inch line to a 20-inch discharge manifold, and thence through a series of lines to the injection wells in the field. The engine-compressors, scrubbers, manifolds and coolers are part of a J. B. Beaird Company packaged compressor plant.

Electric motors to drive auxiliary equipment have been eliminated wherever possible; the SVG engines furnish virtually all of the power to operate accessories. An Ingersoll-Rand centrifugal pump, chain-driven from each engine, circulates cooling water through engine and compressor cylinder jackets, as well as the associated air-cooled radiator. Another engine-driven pump directs lubricating oil for the SVG's through the cooler and through both clay- and wastepacked filters. Each radiator fan is driven by a hydraulic motor powered by a third pump, V-belted to a sheave on the end of each of the engines' crankchafts

Jacket water and lubrication temperatures are controlled automatically by Fulton Sylphon thermostatic valves. Fuel gas is taken from the incoming line after it has passed the first scrubber and is passed through a separate Emco displacement meter which measures fuel consumption for the plant. Starting air is provided by a pair of Ingersoll-Rand Type 30 compressors.

Gas withdrawn from the reservoir is reduced to a pressure of 150 psig and is passed through gas-fired heaters to maintain a 70°F discharge temperature. At each wellhead, there is a Cameron Christmas tree with hand-operated valves and an orifice meter run and

recorder. The gas can be metered on either injection or withdrawal.

Since 1948, Laclede's annual operating revenues have grown from about \$16 million to \$45 million, and sales of gas have increased from about 172 million therms in 1948 to 619 million therms in 1956. (A therm is a unit of heat used as a basis for the sale of town gas and is equal to 100,000 Btu's.) About 70,000 new customers have been added, and Laclede is providing residential heating to more than 163,000 homes as compared to 27.000 serviced in 1948. The Company has a current capitalization that nears the \$92 million mark and which is made up of mortgage bonds, debentures, preferred and common stock, and surplus.

As a RESULT of Laclede's long history, and those of the once independent gas companies acquired by Laclede through the years, the Company's distribution system is fairly complex.

The system consists of 1560 miles of steel and 1360 miles of cast iron pipe, the latter being virtually all within the city limits. The distribution system operates at four pressure levels. They are designated as the feeder, high-, medium-, and low-pressure systems. The first operates at a pressure level ranging from 150 to 75 psig at take points, down to pressures of 25 psig at its tag ends. It is composed of steel pipe, is all of welded construction and is designed to withstand pressures as great as 300 psig. Its purpose is to supply gas to the second and third systems, the high- and medium-pressure network.

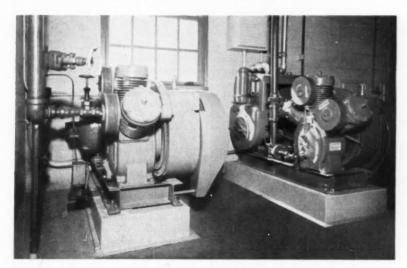
The high-pressure system, also made of steel pipe, operates at pressures ranging from 45 to 5 psig. It delivers natural gas to service pipes supplying customers. Individual regulators are used to reduce the gas pressure to utilization levels. The medium-pressure system is composed almost entirely of cast iron pipe. It operates at pressures ranging from about 25 to 3 psig. Although delivery is made, in some instances, directly to customers, its chief function is to supply, through 141 district regulators, the lowpressure system—the fourth and last distribution network. This, composed chiefly of cast iron pipe, is operated at pressures ranging between 81/2 and 41/2 inches of water, and provides service to the customer at utilization pressures.

Distribution-main investment totals about \$46 million, and Laclede's investment in service pipes is in excess of \$27 million. Including services, meters, regulators and the like, distribution system investment represents \$88 million, or about 77 percent of the Company's total plant investment.

THE WINTER of 1956-57 was comparatively mild and Laclede was not called upon to make substantial underground storage withdrawals. At the start of the winter there were approximately 2 billion cubic feet of gas in storage. During the course of the winter, total withdrawals approximated 180 million cubic feet.

Substantial injection throughout 1957 produced storage inventories of approximately 51/4 billion cubic feet by the end of the calendar year. Heavy withdrawals were not required until about the end of January 1958. But from January 31 until February 21, the weather in St. Louis was severe and continually cold. Storage withdrawals were required over almost the entire period and during this time more than 1/2 billion cubic feet of gas was extracted. The Company's peak demand on its underground reserve was approximately 48 million cubic feet per day. Although the withdrawal period was longer than could have been anticipated in Laclede's planning, the storage performed flawlessly. The success of this project has been definitely confirmed by its operation during this past winter.

It is anticipated that about 7½ billion cubic feet of gas will be in storage prior to next winter, and that during the next winter the Company may be required to withdraw as much as 2 billion cubic feet, and as much as 130 million cubic feet during a single day. Laclede's growth during the last few years has been almost entirely dependent upon the development of the underground storage project. To the people of St. Louis, the project has meant a cleaner city; and for the Company's 370,000 customers, it has produced more economical service.



STARTING AIR COMPRESSORS

In a separate building that houses the plant office and service shop, two Ingersoll-Rand Type 30 compressors are installed to furnish starting air for the SVG's. They are 2-stage machines utilizing three cylinders. Two cylinders (the first stage) are equipped with intake filters. Between stages, air is cooled in fin-type radiators visible on the right side of each unit. One (left) is driven electrically, and the other utilizes a Wisconsin gas engine. They discharge at 250-psig pressure.

AMERICA'S GREAT SLUMBERING FLEET

Unlike the "Red Lead Rows" of a bygone era, today's fleet is scientifically preserved and ready to fight on a moment's notice

J. A. McCormick

ALL OFFICIAL U. S. NAVY PHOTOS

POR more than a decade, the most formidable armada the world has ever known has been slumbering in an atmosphere of controlled humidity under a blanket of special paints and plastics. Critical sensing instruments watch over the giants during their hibernation and recording devices endlessly scribe their state of health. The foregoing statements probably best sum up one of the greatest maintenance undertakings in the history of the United States—the preservation of the reserve fleet.

At the conclusion of World War II, the U.S. Navy was compelled by peacetime economics to decide the fate of her fleet. Experience had taught her the value of preparedness, and the Navy intended to put this into practice by preserving approximately 1200 major ships, the bulk of the fleet. It was immediately apparent that to make this program successful, radical new techniques had to be devised, for up until this time, the method of preserving inactivated ships was largely an ineffective process relying almost entirely upon red lead and grease. Many old Navy men shake their heads sadly, recalling the "Red Lead Rows" of strippeddown rusting hulks that slept between two world wars.

In January 1944, the Navy, working in conjunction with various universities and industrial concerns, launched "Operation Zipper," a scientific investigation into new methods of preserving ships and shipboard equipment, for the materials from which they are made have many natural enemies. The deteriorating effects of salt water, salt-laden air, corrosive vapors, electrolysis, sunlight and dust confronted the researchers with the problems of rust, tarnish, mildew and rot. Techniques had to be developed to effectively preserve unmanned ships of all types and descriptions for indefinite periods of time with only the barest minimum of service. Not only would the methods devised have to be applied easily and cheaply, but, above all, it had to be possible to reactivate the ships to full fighting strength within a few weeks. Despite the complexities of the problems that faced the technologists, the Navy



U.S.S. "SAN FRANCISCO"

A typical nest of mothballed heavy cruisers laid up at the Philadelphia Navy Yard. The ship in the center is the U.S.S. "San Francisco." She distinguished herself at the second battle of Savo Island, November 1942, by inflicting heavy damage on the enemy. As a result of this action she received fifteen major-caliber hits, badly damaging the ship and killing Admiral D. J. Callaghan, among others. For her feats, "San Francisco" received a Presidential Citation.

was prepared to begin the task of scientifically packaging a major percentage of her fleet by the end of the war.

The methods developed as a result of "Operation Zipper" have proved to be extremely successful, and today, the Navy has developed a specific manual covering initial preserving procedure, periodic and routine servicing and reactivation. Although size, compartmentation and equipment may vary from ship to ship, the "mothballing" techniques are generally standardized, and each vessel, regardless of size or class, is packaged in the same systematic and assiduous manner.

As a typical example, let's assume that a currently active ship, say the heavy cruiser U. S. S. Salem, has been selected for mothballing at the Philadelphia (Pa.) Navy Yard. She was commissioned in 1949, and by naval standards, is considered relatively new and modern. Displacing 21,500 tons, she has an over-all length of 716½ feet and a beam of 75½

feet. Her engines develop 120,000 hp and can drive her at speeds in excess of 30 knots, or approximately 34 mph. The ship's wartime complement is 1860 officers and men. The interior of Salem is divided and subdivided throughout. including her outer and inner bottom and hull, into hundreds of small watertight compartments. This makes the ship difficult to sink as a result of battle damage, fire or collision. The mechanical, electrical and special gear crammed into these areas is extremely complex and with the miles of electric cable. pipes and ventilation ducts, resembles what one might expect to see in a wellordered nightmare.

The actual work of mothballing each ship is done by her crew under the direction of a group of highly trained Navy specialists. Every item, from light bulbs to knives and forks, is checked and, if necessary, repaired or replaced. At the same time, all perishables, ammunition and flammable liquids are removed.



CONVERSION

U.S.S. "Canberra", above, was taken from mothballs in 1956 to become the second U.S. guided-missile cruiser. She first joined the fleet in 1944, and after seeing action in the Pacific Ocean, was mothballed in 1946. Scientific preservation techniques made it possible to refit and put both her and U.S.S. "Boston," the first guided-missile cruiser, to sea in record time. At the right, the after turret of "Canberra" is being hoisted from its barbette to permit installation of missile launching equipment.



Then, the old Navy standby of elbow grease and muscles comes into its own, for every part of the ship from the bilges to the mast tips is cleaned. All surfaces requiring it, except the exterior below the waterline, are chipped and painted with a highly efficient anticorrosive paint called zinc chromate. Below the waterline, the hull is highly susceptible to salt-water marine growth which reduces efficiency by creating drag. To counteract this growth, which is very rapid on idle ships, Salem would be drydocked and her bottom scraped and sandblasted, after which a hot, poisonous, plastic paint that repels barnacles is applied. (It is interesting to note that if Salem were actually mothballed at the Philadelphia Navy Yard, instead of other establishments, marine growth would

SURFACE PREPARATION

As shown in these illustrations, all surfaces of a vessel to be mothballed are first stripped of loose paint or scale, and then painted either manually, or with a spray gun. In the picture at the left, an Ingersoll-Rand Size K-1 Scaler is shown in use. These units have nozzles that accept Navy Standard Scaler Chisels having shanks ½ inch in diameter and 1¾ inches long, whether round or hexagonal in section. The other picture (above) shows the "touching-up" operation that fully coats and protects scaled areas.

be negligible since this yard is located along the Delaware River whose fresh waters, according to base personnel, seem to have a favorable chemical reaction on the hull's submerged paint, producing a hard, porcelain-like finish after several years.)

Deck equipment, such as light antiaircraft guns, winches and motors, which is not moved to the ship's interior, is protected by a unique plastic covering. The pieces are first disassembled, cleaned and treated with a special thin-film rust-deterring compound that has extremely long-lasting characteristics. Then they are reassembled, tested and enclosed in an air-tight covering of plastic. In some cases, this is sprayed directly over the equipment, since it has the property of molding itself tightly to any contour; in others, as with the light antiaircraft guns, for example, it is more practical to surround the gun and mount with a light framework of stiff tape, resembling an igloo. Tubing which will permit the circulation of dry air through the igloo is inserted and plastic is then sprayed over this frame, sealing the weapon from the atmosphere. Besides its ease of application, the plastic spray is impervious to the elements and can be peeled in a matter of minutes. The interior of the ship is made airtight by sealing all drainage ports, smoke stacks and other openings with plastic or blanking plates. All small seams are sealed with caulking compound.

While the exterior of the Salem is being thoroughly sealed and protected by a blanket of paints and compounds, sailors are dismantling, cleaning, treating and reassembling every designated piece of equipment within the hull and superstructure. Water tanks, pipes and boilers are drained, flushed, cleaned and similarly treated against rust. Wood, life jackets and all other nonmetallic items are sprayed with mildew-and-decay preventives, and any surface that requires it, is painted.

Since the ship will not be manned while it is in mothballs, special precautions against accidental flooding must be taken. Numerous underwater intake and discharge ports that feed salt water to the ship's fire plugs, sprinklers, flushing and cooling systems are blanked with watertight steel plates. These blanking plates are bolted or welded over the ports while the vessel is dry-docked, and blanks are also placed over the inboard side of the king-size valves that control each port. Lubricant is then pumped into the short connecting piping between the valve and the port, thereby preventing possible freezing and also preserving the valve's mechanism.

Of the various preservation techniques used, that of dehumidification, or the removal of deteriorating moisture from the air, is the most significant. The final major steps in preparing the Salem's

NEW WARSHIP

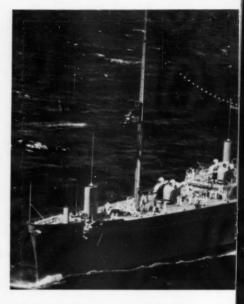
A new type of warship, the U.S.S. "Northampton," is designated as a Task Force Command Ship and was commissioned in 1953. With her extensive radar and communication facilities, she has become a vital element in the United States' defense program. "Northampton" is presently deployed as a unit of our first guided-missile division afloat. The number "1," painted on the hull, indicates that the ship is the first of her class.

interior for inactivation are fumigating, and the removal of any obstruction that would prevent free circulation of dry air through the machinery, piping networks, equipment and compartments. Dehumidified air, kept at 70°F and held to a 30-percent moisture content, not only eliminates the necessity of stripping the interior of the ship of her equipment, thus permitting everything from electronic gear to propulsion machinery to remain intact, ready for use, but also prevents the nesting of rats and insects that cannot live in this desiccated atmosphere.

The operation of a dehumidifier is comparable to a large blower that recirculates air through a drying agent with high-moisture-absorption properties, such as silica gel. The dried air secirculated through every accessible part of the ship and is force fed to remote areas through an easily removable network of large-diameter, thin-gauge tubes. The operation of the dehumidifier is completely automatic; even the desiccant is dried electrically when its moisture content reaches a certain level.

Larger ships, such as aircraft carriers, may require six or seven units to maintain their atmosphere at the prescribed level. Salem requires five. Each dehumidifying unit is electrically driven and controlled by a sensing device that activates the machines as needed. Special recording instruments, that can be read through transparent windows without entering the ship's interior, constantly check the temperature and moisture level. Void areas, blisters and tanks not reached by the dry air are protected by containers of desiccants placed inside. Removing moisture by this method is known as static dehumidifying and requires periodic replacement of saturated containers.

In this manner, Salem is transformed from a self-sustaining, sea-going manof-war to a hibernating parasite that depends upon the Navy yard for electricity to drive her dehumidifiers, water to protect her against fire and personnel to guard her against sabotage and decay. Although initial mothballing is intended to provide adequate protection for at least 20 years without extensive maintenance, inspection and routine servicing are performed continuously. The latter is primarily of a general nature, consisting of checking the moisture indicating



instruments, replacing saturated desiccants, spot painting, sweeping puddles from the decks after rainfalls, etc. The largest, single inspection operation is the dry-docking of the ship every 5 years to check her bottom.

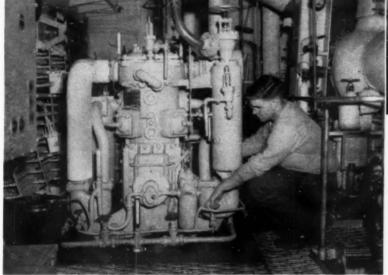
At the present time, there are more than 1200 ships in the mothball fleet. These vessels are well dispersed in shipyards and berthing areas from Maine to Oregon, and even though the Navy is constantly modifying and improving her active ships, the mothball units are not lagging far behind. There are two major reasons for this. First, the over-all design of warships does not change rapidly, and second, warships in any given class are identical in practically all respects to other ships in that class. These factors permit standardized modification design. For example, ten of the fourteen cruisers in the Baltimore Class are in mothballs. Of the active ships in this class, two, U.S.S. Camberra and U.S.S. Boston, have recently been converted to guided-missile cruisers. If necessary, their sisters in mothballs, as well as the other two active ships, could easily and quickly be converted for the same use by utilizing the engineering data worked out for the initial two.

Ships that the Navy considers obsolete are scrapped or sold. Two such are the old battleships U.S.S. California and U.S.S. Tennessee of Pearl Harbor fame. Both have been at the Philadelphia Navy Yard since 1946, and although both are well preserved, they have outlived their usefulness to the fleet. These old warhorses are equipped with d-c generators—all modern ships are using a-c units—and this in itself would have made future modernization impractical because all modern shipboard electrical equipment operates on a-c current.

The practicality of the reserve pro-







INSPECTION

The old guard, U.S.S. "California" and "Tennessee," as they appeared in drydock after having their bottoms in spected in 1950. Both are obsolete and are to be scrapped or sold. The igloolike gun-coverings and the stripped after gun tubs are characteristic of the mothball fleet. The preservation techniques have kept both vessels in top repair. The relic visible at the right is the U.S.S. "Olympia," Admiral Dewey's flagship at the Battle of Manila Bay.

2-STAGE COMPRESSOR UNIT

One of a variety of air compressors used aboard warships is a 2-stage duplex unit rated at 200-psig pressure and manufactured by Ingersoll-Rand Company. It is used for general-purpose air. Preparing compressors for inactivation is a simple operation in which the sump is filled with a special preservative and the machine is operated for a brief period, thus distributing the preservative to all interior parts and surfaces. This is completed by draining the sump, cleaning and applying a preservative to the air-intake valve and cleaning and painting the exterior of the unit. Since the compressor is in a dehumidified compartment, the initial application of preservative will have long-lasting effects.

gram was proved during the Korean conflict when 850 ships were recommissioned to bolster the active fleet. Moreover, the American taxpayer will be happy to learn that there is another very practical aspect to this program. The initial cost of mothballing the reserve fleet was less than 1 percent of the construction cost of the vessels, and their replacement cost today, less armament, would be in excess of \$22 billion.

The Navy realizes that the best preservation techniques would be useless unless the ships could be activated in the shortest possible time. To accomplish this, carefully prepared plans have been drawn. Each Reserve Fleet Group has organized key enlisted ratings and qualified officers into what is known as Activation-Instruction teams. These are assigned to each type of ship in a particular group, and it is their job to acti-

vate the berthing and messing areas in advance of the arrival of the full complement. The regular crew will be called from the reserve and notified to report for duty within 72 hours. When it arrives, the Activation-Instruction teams will supervise the demothballing job.

Although reactivating warships is not easy, it has been simplified as much as possible by the use of detailed instruction tags attached to all equipment requiring processing, and the extensive use of color coding. The use of this streamlined system enables any ship, or group of ships, to be ready for sea in approximately 30 days, without the necessity of having more than a handful of highly trained specialists aboard who are familiar with the mechanics and layout of the ships. The operation resembles the assembly of a huge jigsaw puzzle that has its individual pieces numbered in sequence.



SCENES AT RATTLESNAKE

These photographs were taken in April 1957, at Rattlesnake Reservoir near Loveland, Colo., where Bureau of Reclamation physicists Lloyd O. Timblin, (left in both pictures) and Quentin L. Florey are shown applying and test-ing a monomolecular layer under study as a means of preventing water evaporation. In the illustration below, the flake hexadecanol is being placed in a floating wire basket that was used to distribute the chemical over the 100acre reservoir. It was later found that dispensing the hexadecanol in this manner was unsatisfactory for large water bodies, and that a broadcast method worked better. The other depicts Florey, eyedropper in hand, testing the film pressure of the layer by the oil-test method, while Timblin records data. Film pressure is the difference between the water's surface tension before and after the layer is applied; the surface tension must be less before a drop in evaporation rate will occur. In essence, the oil test method makes use of indicator oils of different film pressures to bracket the pressure of the layer. It is assumed that that of normal water is less than 5 dynes per centimeter and the oils used vary in film pressure from 5 to 40 dynes per centimeter.

Reservoir Protection

CTUDIES scheduled for this spring and summer by the Bureau of Reclamation, U. S. Department of the Interior, may significantly help in the country's struggle to conserve one of its most precious natural resources: water. They are part of a series of experiments concerned with reducing the quantity of water lost from reservoirs every year by evaporation. They are particularly concerned with preventing a large portion of the loss from water storage areas in the arid and semiarid West, where evaporation annually saps from 3 to 8 vertical feet of water.

Research during the last 30 years has shown that monomolecular layers of long chain polar compounds placed upon water surfaces greatly reduce evaporation. This is the method under study by the Bureau.

A monomolecular layer consists of a stratum, 1 molecule thick, that is formed by long molecules aligning themselves side by side, with one end in the water and one end out, much as upright matches in a matchbook. The hydrophyllic, or water-loving end, of the molecule is in the water, while the water-fearing, hydrophobic, end protrudes. This results when a particle of an appropriate chemical, such as hexadecanol, is placed upon the surface. The molecules then form a film which slows evaporation.

Of all the chemicals, hexadecanol, a



long chain saturated alcohol, is receiving the most attention. This compound has been under study since the Australians began work with it in the early 1950's, and now in the United States, the Bureau's major problem is the development of suitable equipment and techniques for applying the hexadecanol to maintain its film.

Hexadecanol is an outstanding material for film formation because it will not react with the hardness chemicals in the water to form a solid layer. Solid layers are quickly fractured by wave action and lose their ability to reduce evaporation. The single-molecule layer which hexadecanol produces has properties as a physical entity, as does any monomolecular layer. It has strength, compressibility, liquid or solid state, and

most important for these studies, film pressure. Film pressure is the difference between the surface tension of the water before and after the monomolecular layer is applied to the surface. It is expressed as dynes per centimeter. For example, assume the surface tension of a water area is originally 72 dynes per centimeter, and after the monomolecular layer is established, the surface tension is found to be reduced to 52 dynes per centimeter. The difference of 20 dynes per centimeter is the film pressure. The layer at the water surface causes the reduction in surface tension, and this reduction must occur before evaporation will be curtailed. Studies to date using hexadecanol to reduce evaporation have been on relatively small bodies of water. However, in some experiments, a maximum reduction in evaporation of 64 percent has been achieved over a period of 2 months. This would mean a noteworthy saving if produced on a large body of water.

Several areas have figured in the studies so far, and final tests will probably be made at a large reservoir named Lake Hefner, located near Oklahoma City, Okla. For several years studies have been made by the Bureau using 4-footdiameter pans; and during the summer of 1956, field tests were conducted at relatively small Kids Lake, near Oklahoma City. There, using hexadecanol, it was found that the material had no apparent harmful effect on taste, odor and color. Further, it found that the substance was nontoxic. More extensive tests on toxicity are being made under contract by the Colorado State University, Fort Collins, Colo. At Kids Lake it was also found that the flake size of hexadecanol is the best form to use for film production; the granular type of the compound was found to be inferior. Studies there developed a means of measuring that critical quality, film pressure, and a search was made to find the answer to the problem of the best procedure for applying and maintaining the film.

During the summer of 1957, studies were moved to a lake near Loveland, Colo., called Rattlesnake Reservoir-a long, narrow body of water of about 100 acres. There, the first film considered to be of real success was produced, using the hand broadcast method with flake hexadecanol. A floating wire basket, also examined as a means of dispensing the chemical, was not found to be nearly as effective as the broadcast method. Unfortunately, studies at Rattlesnake had to be stopped prematurely due to the operational schedule of the reservoir which made the surface too turbulent for tests. Studies then moved to Ralston Creek Reservoir near Denver, Colo., where experiments continued through the fall of 1957. objectives of the first studies at Ralston were to determine the correct amount of hexadecanol to apply to a reservoir for maintaining full coverage, and to find over what time span the compound should be spread. It was learned that a daily 0.2 to 0.4 pounds per acre maintained the evaporation-preventing film, and that this application should be made

throughout the entire 24-hour period. At Ralston Reservoir, the hexadecanol was sifted to the water surface from a boat, although later recommendations were that the best technique would be to arrange dispensers on the upwind shore so that the breeze would distribute the chemical.

The next proposed step in testing the hexadecanol, to be accomplished sometime this spring, is to apply it to Carter Lake Reservoir, a 1000-acre body located in the same area as Rattlesnake Reservoir. If studies proceed successfully, the scientists will be ready for Lake Hefner.

Two physicists, Lloyd O. Timblin, Jr., and Quentin L. Florey, have conducted many of the experiments for the Bureau of Reclamation, working from its Denver offices. Research with this particular chemical and its water-conservation results, however, is by no means confined to the Bureau's work, or for that matter, to the United States. The Southwest Research Institute is conducting similar experiments in Texas, where drought often strikes; and hexadecanol research has been active in Australia and South Africa for several years.

This and That

Fiberglas Torpedo Launchers Thirty Mark 32 torpedo launching tubes are being built by Apex Reinforced Plastics, a Division of White Sewing Machine

Corporation. Each assembly consists of three tubes, made entirely of Fiberglas, plus hardware and electrical equipment. Each has a weight of 2000 pounds, and an over-all length of about 12 feet. Within the tubes are quadrants and adapters to permit the launcher to accommodate various-sized torpedoes up to and including the Mark 44. basic tubes will be centrifugally molded; the quadrants, adapters, covers and other small Fiberglas parts being compression molded. Three high-pressure, filament-wound, Fiberglas bottles that supply the initial thrust for the torpedo will also be provided. Fiberglas was specified for the equipment for two reasons. First, it greatly reduces the topside weight of surface vessels. Second. the material will not corrode, even in salt water.

Nevada's Commission (AEC) has
Blasted taken to tunneling, but the
Mountain agency is more interested
in seeking out scientific

data than pushing through the mountain. Last month it told about an underground atomic bomb that was detonated at the end of an approximately 1900-

foot tunnel on September 19, 1957. The device was set-off well within a 7000-foot mesa mountain located about 65 miles north of Las Vegas, Nev., in the AEC's proving ground. The primary purpose of the experiment was to determine how well underground areas would contain nuclear explosions. This explosion technique has several advantages: it does away with the formation of radioactive clouds, it isn't dependent on weather conditions, and is considerably cheaper than surface detonations that require expensive steel towers.

The bomb, set-off in a powdery, volcanic rock called tufa, was a small one. It was equivalent to about 1700 tons of TNT, less than one-tenth the size of the World War II atomic bombs. The AEC suggested several possible commercial applications for the subterranean blasts: the squeezing of isolated oil deposits into recoverable pools, mining by nuclear methods, and the producing of steam from water-impregnated rocks. AEC scientists thought that perhaps the radioactive blast would make the inner portion of the mountain dangerous for a century, but evidence indicates that radioactivity would provide a small hazard. The highest residual radioactivity located would probably injure a person only if exposure were for an extended period.

The tunnel was 8 feet high, 6 feet wide and continued into the mountain's side for about 1700 feet. There it made a right turn for about 100 feet, made

another right for about 25 feet, and ended in a chamber 6 feet square and 7 feet high. The explosion collapsed the tunnel back to a point some 1400 feet from the entrance. This position is about 250 feet in a straight line from the demolition point. Now, the tunnel has been equipped with electric lights, air and power lines and has the appearance of a horizontal mine shaft. AEC scientists, working in a large chamber holed-out at the start of the caved-in portion, are continuing to gather data. They are directing professional drillers in obtaining sample cores of rock from the inner reaches of the mountain affected by the blast.

The first AEC announcement about the explosion said that it had not been detected by seismic instruments more than 250 miles distant from ground zero, and that only a few of the actual observers of the blast felt the shock. Later reports, however, stated that instruments as far away as Fairbanks, Alaska, detected it.

Although it is customary
Announcing in many parts of the
The Birth world for fathers to pass
out cigars and candy to
announce the arrival of a

child, Prince Rainier devised another method. He proclaimed the March arrival of his second child by breaking ground for a 2-mile tunnel, that will

put Monaco's only railroad underground. Smoke and noise from the line, which links the Casino and the sea, have always irritated the residents of Monte Carlo. It is estimated that the project will require 3 years for completion, and preliminary estimates put the cost at \$4,750,000, a tenth of which is to be paid by the French railway system, and the balance, to be taken from the Royal treasury. The tunnel will run from Monaco station to a point inside France near the town of Roquebrune-Cap-Martin. Rock and earth removed during the driving operation will be dumped into the sea to expand the 1/2-squaremile area of Monaco.

Catching
Cosmic
Rays

Tengland or Padua, Italy, Prof. C. F.

Powell of the University of Bristal hones

Powell of the University of Bristol hopes to catch some of the powerful cosmic rays that strike the earth from outer space. It is expected that the device will soar to a height of about 100,000

feet. The rays about which he is concerned in this IGY experiment are the most energetic known to man. They consist essentially of bare nuclei or "cores" of hydrogen atoms. When these strike the earth's atmosphere, their estimated energy is between one thousand and one million billion electron volts. In comparison, particles from the largest atom-smashing machines devised by man attain a mere ten billion electron volts.

Now that the severity of winter is over, it is pleasant to reëxamine the miracle of snow. Scientists have created miniature snow

storms in their laboratories to discover the reasoning behind one of Nature's most beautiful and dangerous manifestations. Snow forms through the condensation of water vapor on tiny particles of matter, such as dust. These particles are so small (about 0.00005 inch in diameter) that an electron microscope must be used to study them. In colder areas, crystals fall as individual units, but in warmer ones, the crystals

stick together as they descend, making a group known as a snowflake. In extreme cases, flakes may grow to be 4 inches in diameter. After comparing many thousands of these snow crystals by means of photographs, scientists discovered that no two are alike. There have been several explanations offered for this. Dr. Ukichiro Nakaya of Japan, for example, determined after experiments in his cold chamber that the variety is caused by the changes of degrees in temperature and percentages of humidity in the areas through which the snow fell.

City Is Born Of Petroleum Early in March, the Mexican government dedicated a new city that is devoted entirely to petroleum production. The

development, near Macuspana in the State of Tabasco, is called Ciudad Pemex, or Pemex City, and has housing facilities for several thousand workers' families. A modern gas absorption plant and refinery there is connected by a new pipeline to the Mexican oil fields at Minatitlan.

Canadian Miners Set New-

SHAFT SINKING RECORD

DURING the month of November 1957, at Stanrock Uranium Mines Ltd., in the Algoma Blind River district of Ontario, a record was established for deep shaft sinking in Canada, and possibly the world. A crew, pictured above, under the supervision of W. E. Bennett, General Manager for Patrick Harrison & Company, Limited, advanced 408

feet in its Number 2 shaft. The work was done below the 2313-foot level. Final depth of the shaft is 2952 feet. The advance rate averaged 13.69 feet

per contract day and involved the blasting of 86 benches with an average advance per bench of 4.75 feet. Among the equipment in use were eight Ingersoll-Rand D-50 drills, two of these being kept as spares. Compressed air was supplied by two I-R portable compressors: one DR-600 Gyro-Flo rotary and one IKA 500 reciprocating unit. There was no down-time recorded for either the drills or the compressors.

During the record breaking period, 55 sets of timber were hung. These were prepared with the help of 22KW woodborers, and an Ingersoll-Rand Size 534 Impactool was used to fasten the tie and hanging rods which packaged the timbers for their long trip down the hole. Hoisting was done with a Canadian I-R 72x60-inch Class PE-1 unit (left). When the shaft was at 2700 feet, the hoisting time for each bucket was 4 minutes.

EDITORIAL

Water—A Natural Resource

ESTIMATES of the amount of water that will be required in the United States in the year 1975 indicate that about 450 billion gallons will be needed each day. Thirty billion gallons will be required for public water works systems, 131 billion gallons for steam and electric power generation, 115 billion for industrial process use and 170 billion for irrigation purposes. Three years ago, in 1955, the nation as a whole used but 257 billion gallons a day, thus in the 20-year span to 1975 our needs will increase by an estimated 75 percent. The problem now confronting us is where the needed supplies are going to come from.

In THIS land of abundant natural resources, most citizens have been conditioned to believe that our supply of water is inexhaustable, particularly those of us who live outside of the arid and semiarid regions. That the supply can be drained has been brought home quite forcibly in recent years by quantity curtailments and restrictions on the use of water, many of them occurring in regions where such a thing was previously unheard of. In some cases the situation has not been a water shortage as such, but one of insufficient supplies of water suitable for the purposes at hand.

In the years during and following the Industrial Revolution most Americans had little regard for the preservation and conservation of the water with which we were so bountifully blessed. It seemed as though the rivers and streams could never go dry and that if they did, there was a vast and inexhaustible underground reservoir that could be tapped with very little effort. It also seemed that it would be possible to go on dumping wastes into the streams forever—that the little put in would be lost in the vast supply and cause no trouble.

The nation has come to an abrupt reckoning, and it is now seen that water is not a gift of Nature that can be taken without due payment, but is instead a precious resource that must be expended wisely and conserved as much as possible. The problems are costly. It is estimated, for example, that the Chicago area must spend, in the next few years, a minimum of \$300 million to assure adequate water supplies, and the study on which these figures are based attempts to forecast needs only through 1980. Nor does it include the amount that must be spent to handle sewage and other wastes resulting from greater consumption.

DISTRIBUTION of the nation's water is one of the chief problems. Average daily rainfall over the nation is about 4300 billion

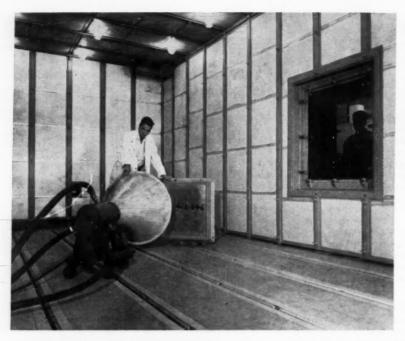
gallons. Obviously only a fraction of this meets our needs, or would if it fell when and where it is required. Many of the great engineering feats of all time have been accomplished for the purpose of redistributing water supplies, thus diverting them to the needs of man.

POLLUTION of the rivers, lakes and streams has progressed so far in some instances that use cannot be made of their waters without extensive and expensive treatment—even so far that Nature's balance is upset. It has been said that although the consequences of past pollution are bad, the act itself cannot be wholly condemned because the role played by cheap and abundant water in the development of the country cannot be overestimated. It is only in comparitively recent years that the pollution has grown to the extent that it may seriously effect future water supplies.

Industry is finding that in many cases it actually is economically advantageous to treat its wastes, or, at least, is not as expensive as it once was thought to be. In one plant, for example, it was determined that more fully utilizing each gallon of water (in an effort to reduce the size of the required treatment plant) saved almost enough money to pay for its operation. Other types of industry are recovering previously wasted raw materials to the extent that the waste treatment plant actually shows a profit.

DEMAND for water in the next 5 years will seriously tax even those facilities that are now considered adequate; some are greatly overburdened at the present. Water works and sanitation engineers are in the midst of planning extensive construction programs to meet these needs. Even the legal aspects of water priorities are under scrutiny. No matter how the problems are resolved and what form new supplies will take, compressed air and fluid transfer equipment will be of great importance.

The development of the centrifugal pump is credited with making possible the supply systems we have today. Compressed air, since the development of the rock drill, has always played a vital part in the development of water works—from pounding through street surfaces to facilitate maintenance and installation of service piping, to putting in the foundations of vast dams. Steam and vacuum are slated for important jobs in the most promising of fresh-water-from-the-oceans schemes. The ground work has already been laid for the utilization of efficient pneumatic tools in building the necessary equipment as well as in installing it.



READYING FOR TEST

Compressed air is forced through a chopper-valve and then through a large exponential horn to produce a noise of 190-decibel loudness. Panels, such as the one placed before the horn in this photograph, will sometimes fail when a resonant frequency is reached at high sound levels. Two 400-hp compressors provide 4000 cfm of air for making noise. An observer at the right looks on from outside the cell. where instruments record data on the test.

TESTING STRUCTURES WITH SOUND

BOEING Airplane Company has completed construction of a sonic test laboratory where studies are being conducted on the destructive effects of sound vibration. Specifically, the company is interested in the harm that engine noise inflicts upon airplane structures. Information gained from the research will aid in the design of sturdier aircraft.

Sound for the tests is generated by compressed air whose flow is interrupted by a motor-driven chopper valve. The resultant pure sine-wave sound is then amplified by an exponential horn to a volume of 190 decibels. To achieve this, the generator uses 4000 cfm of air from two 400-hp compressors. Because the greatest theoretical sound level that can be produced without distortion is 193.7 decibels, the generator works at a very high efficiency.

During a test, a specimen is placed directly in front of the horn. The panel under test vibrates when its sympathetic, or resonant, frequency is reached. It is the amplitude of this vibration which interests engineers. Controls outside the test cell measure and record sound level, resonant frequency, time, amplitude of vibration and the stresses set up in the test panel.

Two test cells have been built at a

total cost of \$350,000. One is 12x30 feet and the other, 8x10 feet. The three doors provided for each opening into the cells are of special interest. two outer ones, built of steel plate, slide closed on overhead rails and a partial vacuum is drawn between them. The inner door, of a bank-vault type, is a metal shell with its interior filled with sand. The sand absorbs sound and dampens vibrations. Latches operated by air pressure keep the doors from being opened while a test is in progress, providing a safety feature. Walls, ceilings and floors of the cells consist of two layers of 12-inch-thick, precast reinforced concrete, with a dead air space between. Surfaces are lined with sound absorbent material. Floor slabs have tie-down rails to support test panels.

The 190-decibel sound inside the cells represents a very high noise level. Decibels, which are units used to measure sound loudness, increase only slightly with large increases in sound energy. For example, when the sound energy is doubled, the decibel figure increases by only three points. Outside the cells in the laboratory area the sound situation is different. Soundproofing has been so effective that outside loudness is only about 70 decibels—a level less than normal office noise.

STURDY DOORS

Bank-vault-type inner doors, such as the one shown in this photograph, are a feature of Boeing Airplane Company's new sound laboratory. This heavy door is a metal shell filled with sand to absorb sound and dampen vibration. A special safety latch, operated by air, prevents the door from being opened while a test is in progress. The large, black outer door to the left is built of steel plate and slides on rollers. Two of these outer doors are placed parallel with one another, and vacuum between the two, made possible by seals, aids in absorbing the great amount of sound produced within the cell.



Dime-Sized Power Plant

TINY high-voltage cells with electrolytes of wax have been developed by the U. S. National Bureau of Standards in an investigation aimed at learning the chemical and electrical properties of batteries with solid electrolytes. The experiments are being conducted at the request of the Diamond Ordnance Fuse Laboratories of the Department of the Army. Their immediate goal is to obtain information helpful to designing batteries for ordnance purposes.

Two sizes of minute, low-current bat-

teries have been produced using a wax electrolyte consisting mainly of solid polyethylene glycol. These batteries are compact, easily constructed and retain high voltage for a long storage period. One is 0.25 inch in diameter and weighs 0.05 ounce with a short-circuit current of 3×10^{-8} ampere. The other is 0.5 inch in diameter, weighs 0.2 ounce and has a 3×10^{-7} ampere short-circuit current. Both are 0.3 inch long and have an electromotive force (emf) of 37.5 v. This battery is expected to be used in main-

taining a charge on a capacitor and producing grid-bias voltage for radio tubes.

The cells resemble a 3-layer sandwich, with the layers consisting of a zinc sheet, a separator and a conductive vinyl film. The separator is impregnated with a zinc chloride-polyethylene glycol mixture and coated on one side with manganese dioxide. Twenty-five disks are punched from this sandwich cell and stacked to form a cylinder. This is lacquered to seal the cell edges and to hold the cells together in the battery. Results show only small changes in the emf of a large majority of the batteries after a 3-year storage.

These experiments did not produce enough data to allow generalizing on how molecular weight of the electrolyte affects current. However, in most cases, internal resistance increased as the molecular weight increased. On the other hand, differences exhibited by separator materials were significant. Experiments with rough filter paper as a separator in one case, and sheets of rayon in another case, indicated that the more openstructured the separator, the lower the internal resistance. Currents from batteries with separators of the most openstructured materials were four or five

HIGH-VOLTAGE CELLS

This photograph illustrates the size of the wax electrolyte batteries by comparing them with a dime and a centimeter rule. The two on the left are 0.5 inch in diameter and the right two are 0.25 inch in diameter. All the batteries are composed of 25 punched-cells sealed together to form a cylinder. Each cell in each battery has three layers, and the electrolyte of solid polyethylene glycol makes up part of the middle layer. The batteries, which have an emf of 37.5 v, were developed by the U. S. National Bureau of Standards during studies of solid electrolytes.

times greater than those of batteries with filter paper separators.

Other batteries were made with electrolytes of gel in place of wax. Ethylene glycol was absorbed by synthetic watersensitive gum to form tacky gels which retained their stickiness over an extended temperature range. These cells had a much lower internal resistance than the wax units and were useful at greater temperature extremes. However, the shelf life of the gel batteries was found to be shorter than that of the wax type.

CENTIMETER 0 1 2 3 4 1

ALCOA GOES TO SURINAM

GREEMENT has been made be-Atween Aluminum Company of America and Surinam (formerly Dutch Guiana) to build a multi-million dollar hydroelectric project in that South American country. Known as the Brokopondo Development, the plan provides for the start of construction of a dam, powerhouse and transmission line to supply 150,000 kw by 1960. It will come into being in what is now a sparsely inhabited jungle area about 80 miles south of Paramaribo, the nation's capital city, and it is expected that it will contribute importantly to the economic development, in terms of forestry, mining and agriculture, of the country. Alcoa, according to the terms of the agreement, will build and operate the power facilities for 75 years, thereafter turning the works over to Surinam at no cost. The government is responsible for providing necessary lands, access roads and sanitation, as well as for removing population and buildings from the proposed reservoir area, one that will be in excess of 500 square miles. In addition, Alcoa will build a 60,000-ton aluminum smelter near the bauxite mining center of Paranam. It will be ready to produce when power is expected to be available. The over-all project, including the eventual construction of a bauxite refinery utilizing local deposits of this ore, will involve a total expenditure of approximately \$150 million. Eventually, Surinam, long one of the world's largest suppliers of bauxite, will become the fourth aluminum-producing country in the Western hemisphere.

It is interesting to note that for 42 years, Alcoa has conducted bauxite mining operations in Surinam through a subsidiary company, Surinaamsche Bauxite Maatschappij. The concern's name will now be changed to Surinam Aluminum Company, and, as Suralco, it will direct all Alcoa activities in that country involving power development, exploration, mining and aluminum smelting.

SAVING WITH AIR POWER

One Clamp Serves Entire Plant

Power clamping was needed on a variety of machines in a Wichita, Kan., facility that sub-contracts machine-shop work involving a variety of aircraft and agricultural machine parts. Since different machines need automatic clamping at different times, it was not feasible to make a permanent installation on any one unit.

The problem was solved by Wilton Tool Manufacturing Company, Inc., and its PowRlock. The device is an automatic, air-hydraulic clamp that can be used to replace manual set-up clamping on any standard machine or fixture. It consists of a clamping head, booster, filter-lubricator, control switch, and interconnecting tubing. In this particular installation, the air-hydraulic booster and filter-lubricator are mounted on a small table. After the PowRlock set-up has finished its job on one machine, the air hose is disconnected, and the table is moved to another machine. The air hose is then reconnected, and the clamping head immediately put to use. The results have considerably increased production by cutting loading and unloading time to a minimum and workers are pleased with its convenience. Although the firm is using one clamping head at present, the booster enables them to add more heads in the future as they are



CLAMPING OPERATION

The illustration above shows Wilton Tool Manufacturing Company, Inc.'s, PowRlock in action. Its air-hydraulic booster and filter-lubricator are mounted on the small table. When the worker has finished his clamping operation, the entire unit is disconnected from the air line and can be then moved to another machine.

AAF Cycoil Oil Bath Air Cleaners Give **Positive Protection**

AAF Type "W" Cycoils have proved themselves in thousands of installations—even where dust conditions were most severe. High collection efficiency and virtually maintenancefree operation have made Type "W" Cycoils favorites in all industries.

The operation of the Cycoil is unique. A combination of oil impingement, centrifugal action, and filtration results in practically 100% dust removal in standard A.S.H.V.E. tests. Would you like more information? Write for our illustrated catalog.

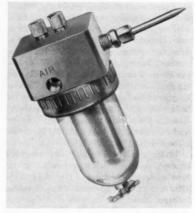


COMPANY, INC. 402 Central Avenue, Louisville 8, Kentucky American Air Filter of Conada, Ltd., Montreal, P. Q.

Industrial Notes

With this issue, COMPRESSED AIR MAGAZINE is discontinuing use of the literature request card. Addresses of manufacturers whose products are described on these pages are part of each item. Please correspond directly with them for further information.

TWO LOW-COST wheel bearings developed by The Timken Roller Bearing Company are well suited for use in small industrial conveyors, in farm machinery and boat trailers. They were designed as wheel bearings for small cars of the European type and for similar cars which may eventually be produced in this country. The manufacturer reports that close control of manufacturing processes is mainly responsible for the bearings' low cost; it is said that they are the most economical ever produced by Timken. The larger bearing has a bore of 1.0625 inches, 1.980-inch OD and a width of 0.560 inch. The smaller model has a bore of 0.6875 inch, a 1.570-inch OD and a width of 0.545 inch. The Timken Roller Bearing Company, Canton 6,



SIMPLICITY of mounting and operation is said to be an advantage of the Arrow Jet-Mist Generator, which is designed to pin-point air-liquid coolants or air-oil lubricants directly to cutting areas during high-speed machining, metal drawing and forming operations. It uses a machine tool sump pump with a ½-inch National Pipe Thread (NPT) air-line connection to spray a single or multi-jet mist coolant to the exact working point. The device can be used on

REDUCE OPERATING COST of VACUUM SYSTEMS with this "AERO" (air-cooled) VAPOR CONDENSER

With free air the cooling medium you use the least water, evaporated in the air stream. You save the cost and pumping of large volumes of condensing water.

Air-vapor subcooling reduces mixture evacuated from the system, saving in the operation of steam ejector or vacuum pump.

This air-cooled condenser gives you more capacity than other types at a substantial saving of steam and power. Water supply, scaling treatment and disposal problems are eliminated.

You get pure condensate, an improved product; often make a profit on recovery of residues now wasted. There can be no contamination of your product at any time; it never touches raw water. Condensing, of water, of solvents or of your product, is simplified; you have one, compact,



Niagara Aero Vapor Condenser. This compact machine may be installed directly above stripping column or vacuum evaporator.

easily maintained unit replacing both cooling tower and barometric or surface type condenser.

Maintenance expense is low. Balanced Wet Bulb Control provide precise, year 'round adjustment of capacity to load.

Constant temperature, uniform products and maximum production 12 months a year are assured. Unit capacities up to 15 million BTU.

Write for full information. Ask for Bulletin 129R

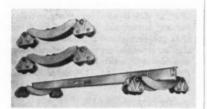
NIAGARA BLOWER COMPANY

Dept. CA-4, 405 Lexington Ave., New York 17, N.Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

machine tools for grinding, turning, boring, milling, sawing, drilling, tapping and other operations. The manufacturer states the generator requires no pressurized coolant tanks, regulator valves, control panels, or special spray heads. Longer tool service life, improved product quality and increased production have been the reported results. Arrow Tools, Inc., 1921 South Kostner Avenue, Chicago 23, Ill.

UNI-KIT Crane is sold as a low-cost, off-the-shelf package unit that is available for 4000-pound-capacity crane assemblies with spans as great as 30 feet. The kit contains two truck frames, four crane trolleys and all necessary bolts and fittings, and reportedly can be assembled quickly using only simple hand tools. It is specifically designed to meet light-duty needs or to fill temporary,



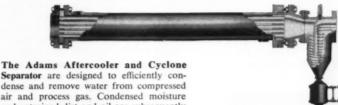
emergency handling requirements where heavy-duty equipment is not readily available and its expense not justified. The trolleys are constructed with an adjustable feature permitting their use on a wide variety of existing runway-beam sizes, and in some cases, on the structural beams of the building. Wheels are furnished for either tapered or flat flanged beams. The Becker Crane & Conveyor Company, 4900 Ridge Road, Cleveland 9, Ohio.

A SOUVENIR desk weight that is a replica of a Microflat Black Granite Surface Plate, and a bulletin describing the Microflat line are available without charge from the manufacturer. Microflat Black Granite is geologically classified as Hypersthene Gabbro, and it is said that it affords the user the advantages of nonwarping, nondeflecting, easily washable, smooth, inert, rigid and moisture-repellent products. Collins Microflat Company, 3429 W. El Segundo Boulevard, Hawthorne, Calif.

No LUBRICATION is needed with a gear coupling that reportedly can withstand as much torque as 1800 inchpounds, the result of stress-relieved, injection-molded nylon gears. Interchangeable bushings are available for the coupling, designated the 162M and first in the series "M" line. The gears are held in place on steel hubs by spring

Aftercooler and Cyclone Separator designed for cleaner, dryer compressed air

R. P. ADAMS CO., INC. 209 East Park Drive, Buffalo 17, New York



The Adams Aftercooler and Cyclone Separator are designed to efficiently condense and remove water from compressed air and process gas. Condensed moisture and entrained dirt and oil are subsequently removed in a cyclone type separator. This unit is scientifically designed for maximum removal efficiency over a wide range of flow rates.

For normal use, units are available to cool gases to within 10° F of the temperature of the cooling water. Specially designed units are available to permit a 2° F approach to cooling water temperature, for application where low moisture content is critical.

Adams Aftercoolers and Separators are available from stock to handle 20 - 40,000 cfm with 10° cooling and 25 - 19,200 cfm

where it is necessary to cool within 2°F of the cooling water. Special units can be supplied to suit an unlimited range of requirements. In all cases the maximum pressure loss at rated capacities is ½ psi.

This wide range of sizes enables the economical utilization of Adams Aftercoolers and Separators in virtually all industrial application. For further information on how R. P. Adams' units will solve your compressed air problems and save you money, write today for Bulletin 711.



world's most respected motor

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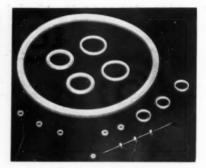


rings, allowing a smooth, resilient contact with the device's steel sleeve. Interchangeable bushings are available for

OFE

shaft sizes from ½ to 1% inch. Each coupling weighs 6½ pounds and is compact enough to fit short shaft extensions. John Waldron Corporation, P. O. Box 791, New Brunswick, N. J.

CHEMICAL and mechanical seals of Teflon, with dimensional tolerances of 0.001 inch and less, are being produced for extreme temperature, pressure and corrosive applications in the chemical process, aircraft, electronic and other fields. Initial production has been chiefly concerned with O- and V-rings with square, round and oval cross sections. Sizes are presently limited to a maximum OD of 15/16 inch and ID of 3/4 inch; some as small as 3/32 inch OD. With new machining techniques, it is said that "wall" thickness can be kept to 0.062 inch, on a production basis, and down to 0.012 inch on small-lot, devel-



opmental seals. Where better-than-commercial tolerances are required in miniaturized or high-pressure applications, dimensions can be held to within 0.001 inch and less in certain designs. Furthermore, they are machined from a highdensity, high-polymer TSI Teflon rod stock recently developed. Some seals have been subjected to pressures of 30,000 psig, temperatures from minus 200° to 425°F and corrosives, such as fuming nitric acid, without failure. In food processing and medical equipment, the inert seals prevent contamination and do not need lubrication. Point Plastics, Inc., 175 I. U. Willets Road, Albertson, Long Island, N. Y.

STEAM TRAPS, with an impellerdriven rotating valve that is said to prevent uneven wear of the valve and the orifice, and stop costly steam leakage, combines a bucket, valve and im-



now!

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ON MANY TYPES AND SIZES OF

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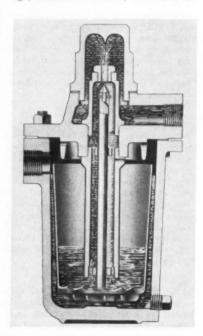
Need silencers on short notice? Contact Maxim. We are now stocking an increasing number of the more widely used types and sizes. As a result, we may be able to give you immediate delivery.

If the type and size you need is not in stock, you can still depend upon Maxim to give you best delivery—from the most complete line of industrial silencers. Equally important, you can count upon outstanding performance—in the tradition that has made Maxim the preferred silencer throughout industry. Maxim, more than ever, stands for special customer service.

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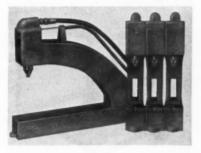
61 HOMESTEAD AVENUE . HARTFORD, CONN.



peller into its only moving part. The impeller changes the seating position of the valve at every discharge not only to halt the uneven wear, but to keep sediment agitated so that it passes out with each condensate discharge as well. A removable cap permits inspection of the valve and seat without disturbing high-pressure bolts or gaskets. H. O. Trerice Company, 1420 W. Lafayette Boulevard, Detroit 16, Mich.

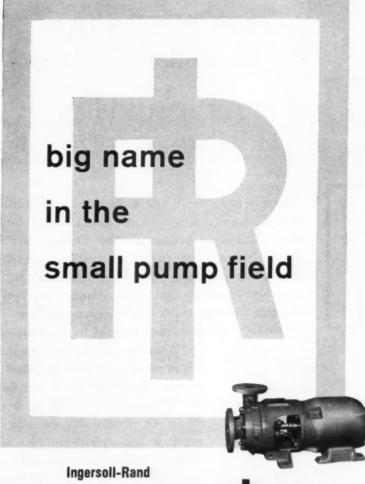
SELF-ADHESIVE felt, precut in a wide variety of shapes and sizes, is available for such uses as insulating, cushioning, and for keeping out moths, fungus and vermin. Quik-Felt, as it is called, is mounted on quick-dispensing cards. It is said that mere finger pressure is needed to assure adhesion to glass, ceramics, wood, metal and plastics; no special tools are used to apply the material, which is available in standard shapes as circles, rectangles, squares and strips. Special sizes of the felt can be made to order. It is reported Quik-Felt is ideal for dust seals for office furnishings; it can also be used to keep high temperatures from reaching heatsensitive equipment and as a shock-absorbent material for shipment of the W. H. Brady Comsame equipment. pany, 727 W. Glendale Avenue, Milwaukee 9, Wis.

PNEUMATICALLY operated impact hammers with a slim-line design for multiple installation are being built for staking, swaging, cutting, marking and punching. Called Airchamps, the hammers can be set for multi-stage operation



on 2½-inch centers. As many as ten can be operated from a single ½-hp air compressor rated at 1½ cfm. The device reportedly delivers 50 two-inch strokes per minute; has a clearance, in ram height, from the base of 5 inches; and offers a 10-inch throat. High Speed Hammer Company, Rochester, N. Y.

STRENGTH of 2000 pounds is said to be a feature of an industrial clamp that uses the worm-gear principle. Its manufacturer says the fixture is the first of its type to successfully use this feature, and reports the device provides an air- and moisture-tight seal in steel, aluminum, plastic and other containers.



MOTO R PUMP

FOR MORE THAN 90 YEARS Ingersoll-Rand pumps have been demonstrating that highest quality construction means low-cost pumping efficiency.

Modern, compact Motorpumps—designed in a wide range of types and sizes, and always available—are meeting requirements in hundreds of varied installations.

Motorpumps will deliver from 5 to 2800 gallons per minute. They operate in any position and save valuable floor space as well. Write today for complete catalog data.

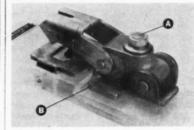
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CONTINENTAL "S" Assemblies Save Money in the CONSTRUCTION INDUSTRY

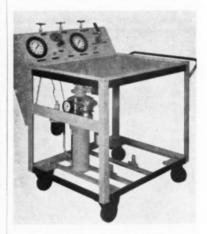
Good news for every user of construction equipment with Continental power! All models in the Continental line of industrial engines are now available in "S" Assembly form—basic engine unit complete with cylinder-and-block assembly, oil pan, cylinder head, piston and valve assemblies, crankshaft, camshaft, gear cover, bearings and caps, crank and cam gears and front end p! te, fully assembled and torqued to specifications.

"S" Assemblies usually cost less than full overhaul, and they install in a fraction of overhaul time. And since the "S" Assembly embodies the latest results of Continental's continuing research, as regards both materials and design, it enables you to keep the very latest model on the job at all times. Coupled with its strength, the clamp withstands shocks and vibrations, adjusts to varying manufacturing tolerances and cuts installation costs because it eliminates the necessity for precision mounting. Opening and closing is accomplished by rotation, with a 7/16-

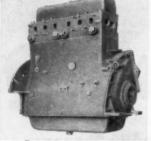


inch wrench, of the nut at point "A" in the photograph above. This turns the gear at point "B," making use of the worm-lock principle. It is said the clamp has broad application since it combines the holding power of nut-and-bolt fasteners with the adjustability of resilient devices Specialty Hardware Department, The Bassick Company, Bridgeport 5, Conn.

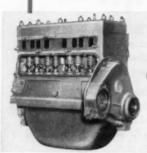
AIR-OPERATED portable stands, designed for simplified testing of aircraft and industrial hydraulic compon-



ents and systems, require only shop air for operation, thus permitting tests anywhere within reach of shop air lines and in hazardous areas with complete safety. Standard units have either one or two test outlets. The dual outlet stand also can be supplied with a 4-way selector valve in order to cycle the component being tested. Individual units reportedly provide maximum pressures from 3000 to 30,000 psig. The entire unit, designated KC-854, is mounted on a portable, welded-steel cart that has a 750-Kahn & square-inch work tray. Company, 543 Windsor Street, Hartford 1, Conn.



DIESEL



L-HEAD



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A unique salt source consists of pools of Pacific Ocean water trapped behind high sand barriers on the west coast of Mexico. It is replenished by high tides several times annually, between which floodings the sun and wind evaporate the water without further dilution of the pools

During the 1957 fiscal year, the Bureau of Reclamation added 160,000 acre-feet of reservoir capacity and 57,000 kw of hydroelectric generating capacity to the projects administered by the agency.

Nebraska has witnessed an electronic highway auto-control system designed by Radio Corporation of America. It has electronic detectors buried in and along a 300-foot experimental section to control speed and braking, and a guidance cable buried in the center of the traffic lane for steering.

One towboat, pushing twelve averagesized barges on the Mississippi River, can move almost twice as much oil as can an ocean-going tanker of 16,000 tons.

America's offshore oil fleet will grow by an estimated 220 crew boats, 50 supply boats and more than 300 cargo barges in the next 14 years, it has been estimated by the American Petroleum Institute.

Aluminum missile and rocket bodies and their structural parts are being made by impact extrusion techniques, according to Harvey Aluminum Company.

Prefabricated brick houses are now available and successful. Five men erected one with a total of 1200 square feet of panels, 36 bricks to the panel, in 81/2 hours.



"I have to stay and finish some letters.

"ALLSERV"



GENERAL PURPOSE HOSE

ANOTHER GOODALL Quality PRODUCT

Versatility is demonstrated to the Nth degree in this fine hose-built to Goodall's high standards for materials and workmanship.

"ALLSERV" will not only give long, reliable service on air and pneumatic tools, but will prove equally efficient in the handling of water, oil, gasoline, paint and insecticide spraying, grease guns, etc. The adaptability of this one hose to such a wide variety of applications provides a sure way to keep hose inventory low.

"ALLSERV" is a very flexible all-"Synplastic" molded-and-braided hose, in one, two or three braid construction, with a tough wear-resistant red cover. Made in sizes 1/4 " to 1/2 ", for working pressures from 200 lbs. to 300 lbs.







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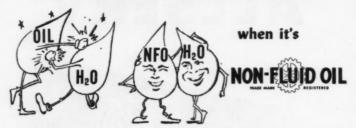


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Yes, oil and water DO mix



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- · Complete rust-proofing of air tools.
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Birmingham, Ala. Columbus, Ga. Atlanta, Ga. Charlotte, N.C. Greenville, S.C. Springfield , Mass. Detroit, Mich. Chicago, Ill. Greensboro, N.C. Providence, R.I.

St. Louis, Mo.

Industrial Books and Literature

THREE models of wagon drills are described in Ingersoll-Rand Company's Form 4191: its FM-4 wagon drill, FM-4 rotary and its lightweight JHM Wagonjack mounting. The first, said to be the "workhorse" of the three, is a percussion drill designed for sustained work on road, general construction, foundation and quarry jobs. The FM-4 rotary is designed for fast drilling with fishtail bits in soft formations where percussion drilling isn't practical. In locations where the weight of the drilling unit is of prime consideration, the third is recommended. All the units discussed can work in almost any position and are 1-man operated. Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y.

MAX JAKOB'S Heat Transfer (Volume II) has been published by John Wiley & Sons and is concerned mainly with applications of the subject; the initial volume was primarily devoted to theoretical concepts. The organization of the second volume follows that of the first. It begins with Part F containing two chapters on heat radiation.





WHO FORGES THE TOUGH CRANKSHAFTS?

.... and machines them, too



NATIONAL FORGE 6 ORDNANCE COMPANY

IRVINE, WARREN COUNTY, PA.

COMPRESSED AIR MAGAZINE

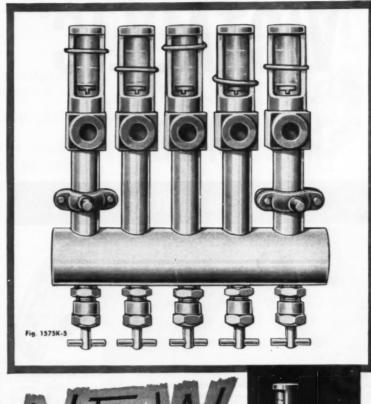
Part G details selected applications relative to heat transfer in thermometry and related branches of measurement, ordinary heat exchangers (recuperators), regenerators, cooling towers, cooling by falling liquid films, cooling of surfaces exposed to hot gases, heat transfer through laminar and turbulent boundary layers at high fluid velocity, heat transfer in liquid metals and steady-state heat transfer in packed columns. This is followed by an extensive supplement to Volume I. Volume II was put into final form by Stothe Peter Kezios, associate professor of mechanical engineering at Illinois Institute of Technology. The late Dr. Jakob was long associated with the Institute, where he was research professor of mechanical engineering. Cost, \$15. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y.

DEMOLITION and digging tool accessories offered by Ingersoll-Rand Company are catalogued in a 24-page bulletin (Form 4190) released by the manufacturer. Also included is a full-page guide that instructs the reader about the correct methods for reforging, sharpening and hardening the accessories. This can be removed from the pamphlet and posted in the reconditioning shop for quick reference. Another special section describes I-R safety tools of forged beryllium copper, designed for applications where nonsparking is essential. In all, some sixteen variations of the company's line are listed, along with 64 Ingersoll-Rand Company, accessories. 11 Broadway, New York 4, N. Y.

RIGID VINYL plastics that are available in a variety of extruded forms are the subject of a booklet called *Geon*. Two types are discussed: 8700-A and 8750. The physical properties and chemical immersion data of the two are compared. Shapes available are depicted along with an explanation of such ap-



"When Delany was foreman he insisted that everyone take an aptitude test."



.. from NUGENT PRESSURE SIGHT FLOW LUBRICATORS



Fig. 1575

Now you can deliver lubricating oil or other liquids under pressure, in accurately measured quantities, to high or otherwise inaccessible points with the Nugent pressure sight flow lubricator. They are available as single units or in multiples to 15 depending upon the number of feeds required.

Each lubricator making up a multiple unit is capable of feeding fluid in amounts varying from several drops to two pints per minute by simple adjustment of the individual needle valves.

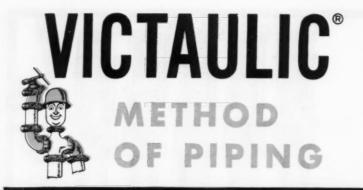
Single lubricators are available with 1/4" or 3/8" ips inlet and outlet. Inlet sizes of multiple units range to 3/4" ips with 1/4" or 3/8" ips outlets. All are designed for 125 psi maximum working pressure. Write for complete details.



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VICTAULIC COUPLINGS ROUST-A-BO

Simple, fast, reliable. Styles 77, 77-D, for standard uses with steel or spiral pipe, — Style 75 for light duty. Other styles for cast iron, plastic and other pipes. Sizes ¾" to 60".



ROUST-A-BOUT COUPLINGS

For plain or beveled end pipe Style 99. Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 12".



VICTAULIC SNAP-JOINTS

The new, boltless, speed coupling, Style 78. Hinged into one assembly for fast piping hook-up or disassembly. Hand locks for savings in time and money. Ideal for portable lines. Sizes 1" to 8".

plications as moisture eliminator chambers in large air conditioning systems, tracks and frames for windows, and wiring ducts for switchboards. Design advantages of the Geon compounds are listed, and two curves give information on tensile strength plotted against temperature, and creep behavior with the percentage of extension plotted against time. B. F. Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio.

A WELDING, cutting and brazing guide is contained in The Welding Directory, a volume compiled by the editors of Industry & Welding and Welding Illustrated. It lists more than 350 products, 1700 names and 2000 welding distributors. The book is divided into five sections: a products list; a trade names index, which also presents both product descriptions and manufacturers' names and addresses; a manufacturers' catalogue giving an alphabetical arrangement of booklets, specification data and special advertisements; a reference manual; and a compilation of the merchandise carried and services offered by distributors. Cost, \$6.50. The Industrial Publishing Corporation, 812 Huron Road, Cleveland, Ohio,

CONDUCTIVITY and resistivity as well as the chemical composition and mechanical properties of a nickel-clad copper wire is given in Kulgrid 28, Nickel Clad Copper Wire. The material is suitable as an electrical conductor where oxidizing conditions or corrosive atmospheres exist, as in lead wires to heating elements in electrical resistance furnaces, electrical appliances and vacuum tubes, and hookup wire in electronic equipment such as induction furnaces. The booklet contains the results of comparative laboratory tests made on its Sylvania Electric Prodresistivity. ucts, Inc., 1740 Broadway, New York 19, N. Y.

CONDOR LS V-belts, featured in a 4-page bulletin (M210), are made for long center, heavy-duty drives and are said to have a precision proportioned construction that eliminates harmful whipping. It is also claimed that belt sets stay matched with a high degree of lateral and longitudinal stability. Raybestos-Manhattan, Inc., Manhattan Rubber Division, Passaic, N. J.

LAKE SHORE, Inc., has published a 16-page illustrated mining catalogue. It details such equipment as mine cars, dumpers, sheaves, skips, guide rollers, cages, safety dogs and timber trucks. Lake Shore, Inc., Iron Mountain, Mich.

COUPLINGS FOR EVERY PIPING JOB



VICTAULIC FULL-FLOW FITTINGS

Elbows, Tees, Reducers, Laterals, a complete line—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes ¾" to 12".



VIC-GROOVER TOOLS

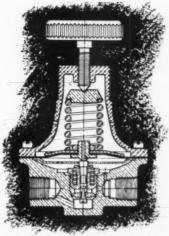
Time saving, on-the-job grooving tools. Light weight, easy to handle — operate manually or from any power drive. Sizes 34" to 8".

PLUS FITTINGS AND GROOVING TOOLS

"EASIEST WAY TO MAKE ENDS MEET"

Promptly available from distributor stocks coast to coast. Write for NEW Victaulic Catalog-Manual No. B-4

VICTAULIC COMPANY OF AMERICA
P. O. BOX 509 • Elizabeth, N. J.



FOR PRECISION REGULATION

SMALL VOLUME AIR PRESSURE REGULATORS

The Conoflow Model H-10 Precision Regulator is an inexpensive, reducing-relief type regulator. Ideal for small volume or "dead-end" service. In low ranges it is capable of maintaining set pressures to within .005 psi regardless of vibration or upstream pressure variations. Can be supplied in modified form for precise regulation on liquid flow.

It is used as a standard by many nationally known equipment manufacturers. Streamlined design of all brass and stainless steel construction. Available for flush panel or line mounting in ¼" pipe size. Spring ranges from 0-5 to 0-125 psi.

Price: \$9.50 • Discounts for quantities.



WRITE FOR BULLETIN H-2 ON PNEUMATIC REGULATORS

CONOFLOW CORPORATION SUBSIDIARY OF WALWORTH COMPANY 2105 ARCH STREET • PHILADELPHIA 3, PA.

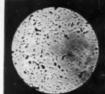


AMAZINGLY SUPERIOR BEARING BRONZE

BEARIUM METAL

The unique structure of Bearium Metal combines not only the best features of babbitt and bronze, but, in addition, has desirable frictional characteristics that are exclusive.

- * It will not melt out like babbitt.
- ★ It does not score like an ordinary bronze.
- ★ It definitely puts an end to all problems ordinarily encountered in frictional applications.



BEARIUM METAL magnified 25 diameters shows lead (black) in microscopic, globular form, uniformly distributed.



ORDINARY LEADED BRONZE at 25 diameters shows poor lead distribution, with lead between copper grains.

Write for Full Information on this Amazing Bearing Alloy

BEARIUM METALS CORP.

191 Mill St., Rochester 14, N. Y.

WEST COAST AFFILIATE: Nevin Engineering Associates 208 Toyopa Drive Pacific Palisades, California IN CANADA: Bearium Motals of Canada, Ltd. 155 George St. Toronto 2, Canada

DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY

A COMPLETE SELF-CONTAINED UNIT



DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

DRIAIR speeds production by separating and automatically ejecting the condensed water and

oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

Scale model of new Chase Manhattan Bank Building, now under construction in down-town Manhattan. Foundations for this structure will be set in solid rock, 85 feet below street level.

The 900-cfm Gyro-Flo portable compressor shown in the foreground heads a line-up that includes four 600 cfm units, only the tops of which can be seen.



Line-hole foundation drilling, four holes to the foot, is being done with this quarry-bar setup using Ingersoll-Rand DB35 drifter drills on JHM Wagonjack mountings.

GYRO-FLO in the news

3300 cfm of Gyro-Flo Air Power Helps Prepare Excavation for New Skyscraper

In downtown Manhattan, New York City, there is in progress "the" most difficult foundation job in the world – The Chase Manhattan Bank Building Foundation. The sixty story edifice of steel and glass will be set on a foundation carried down to and into solid bed rock, at a depth of 85 feet below street level.

The foundation construction, the most important phase of the complete project, is progressing rapidly under the skilled management of The Foundation Company, George M. Brewster, and Joseph Miele Construction Co. with Lou Miller as project manager, Gene Fullam, General Superintendent.

SIDEWALK SUPERINTENDENTS

To the "sidewalk superintendents" who daily help oversee the job, Ingersoll-Rand Gyro-Flo compressors have been a familiar sight. When the job first started, there were five of them down in the big open pit (one 900 cfm and four 600 cfm units) supplying 3300 cubic feet of air per minute for the drilling operation. As the job rapidly progressed and the need for air decreased, three of the 600 cfm units were taken off the job and placed at another.

Not so conspicuous, but equally important, are the rock drills which operate deep below the surface. Line-hole drilling, four holes to the foot, is accomplished at a rapid pace by Ingersoll-Rand DB35 drifter drills with JHM Wagonjack mountings on 20-foot quarry bars.

WINNING COMBINATION

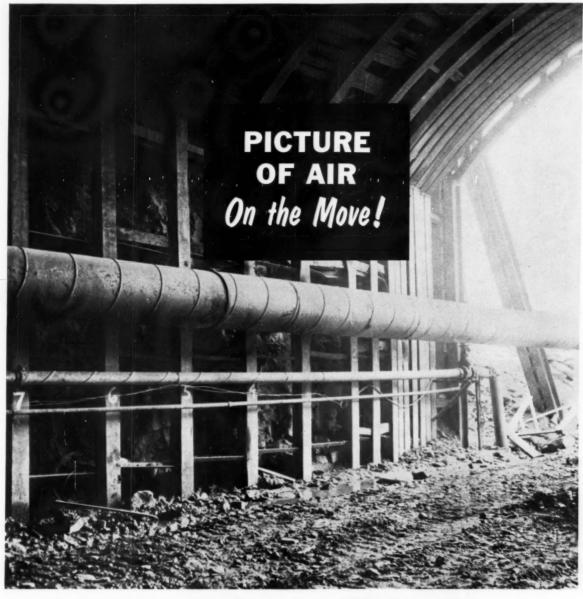
This combination — Gyro-Flo air power and I-R rock drills — has helped building contractors meet the tightest schedules on major jobs all over the world. Gyro-Flo rotary compressors, available in sizes from 85 cfm to 900 cfm, deliver a constant supply of 100 psi air with practically no attention or maintenance. Their on-the-job dependability has become the standard by which all others are judged. And their rugged all-weather construction keeps them on the go under the most severe atmospheric and climatic conditions.

For information on how Gyro-Flo air power can help you speed up construction and avoid costly delays, just call your nearest Ingersoll-Rand representative.



Ingersoll-Rand

AN UNBEATABLE COMBINATION ... GYRO - FLO COMPRESSORS AND I-R ROCK DRILLS



Lines of NAYLOR Spiralweld pipe provide a dependable way to move air. Getting rid of smokes, fumes and dusts; supplying fresh air for underground construction; or bringing in compressed air for operating tools, you can rely on this distinctive pipe to do the job.

NAYLOR pipe is light in weight, easier and more economical to handle and install—particularly with the one-piece NAYLOR Wedgelock coupling to speed connections. The spiral-lockseam structure assures greater collapse strength and safety, making possible the use of lighter gauge material for economy in push-pull ventilating service.

Specify NAYLOR for air, water, ventilating, drainage, dredging and other lines to get this extra performance.

Write for Bulletins 507 and 513 for complete details.

INAYLOR

NAYLOR PIPE COMPANY

1245 East 92nd Street, Chicago 19, Illinois

Eastern U.S. and Foreign Sales Office 60 East 42nd Street, New York 17, N. Y.

Nickel alloy steel piston in percussion drill head stands brutal 200-blow-per-minute pounding

The heart of the percussion machine on Ingersoll-Rand's Quarrymaster is an air-operated piston drill. It can wham a 6" blast hole through the hardest rock 10 feet an hour . . . through softer rock 80 feet an hour.

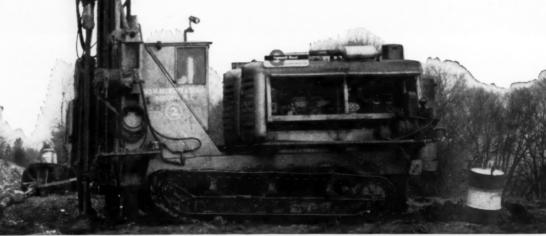
And what a battering the piston takes in the process! Absorbs over 200 heavy blows per minute. Made of heat-treated nickel alloy steel, it stands the gaff as proven by satisfactory performance.

Ingersoll-Rand Standardizes on Nickel alloy steels for the tough jobs

Ingersoll-Rand uses nickel alloy steels for other parts in its powerful piston drill . . . for the rifle bar and for other major components in the Quarrymaster. Uses nickel-containing steels because they withstand impact, shock, and the tough operating conditions routine in pit, quarry and construction drilling.

Do you have a metal problem that's tough to solve?

A nickel alloy steel may be the answer. Send us the details of your problem, and we'll be happy to suggest a grade for you.





THE INTERNATIONAL NICKEL COMPANY, INC. 87 Wall Street



In its Lake Parker Plant, the City of Lakeland, Florida, utilizes 11 air compressors... for air-operated combustion control, for pneumatic tools, and to power

soot blowers for cleaning boilers. These compressors are on duty day and night to supply dependable electric power to more than 60,000 customers.

TO PROTECT POWER GENERATING PLANTS:

Lakeland, Florida, guards against air compressor fires and explosions with fire-resistant Pydraul AC

Like all American cities, Lakeland progresses on constant and reliable electric power day in and day out.

To insure this dependable supply of electricity, Charles Larsen, Superintendent Light and Water Department, specifies fire-resistant Pydraul AC as the lubricant for all Lakeland power plant air compressors. As Mr. Larsen points out, "Pydraul AC gives more than excellent lubrication. It also protects us against fire and explosion dangers in our air compressors. You can't really measure that advantage and security." Pydraul AC will also minimize carbon deposits on exhaust

valves and air piping systems... where fire danger really lurks!

Conversion is easy...essentially, just drain your flammable oils and replace with fire-resistant Pydraul AC.

Send in the coupon for your copy of the Pydraul AC booklet...it answers compressor lubricant questions.

Pydraul: Reg. U. S. Trademark

Organic Chemicals Division

MONSANTO CHEMICAL COMPANY

Dept. CA-2

St. Louis 24, Missouri



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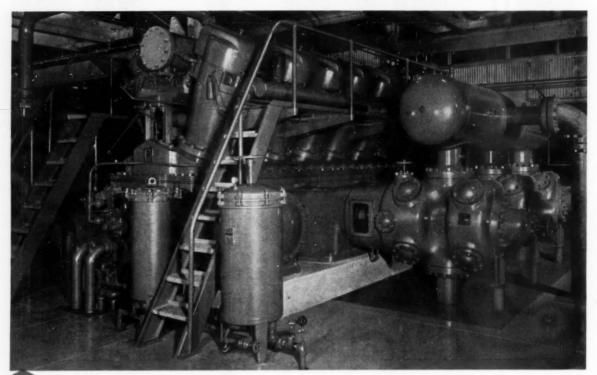
Please send me the Pydraul AC booklet.

Name Title

Firm

City State

AUTOMATIC CONTROLS



This 1320-hp Ingersoll-Rand KVG gas-engine compressor is in operation at the Hooper Station of Northern Natural Gas Co. The unit is arranged for fully automatic operation as noted below.

CONTROL PHASES PROVIDED

Starting Control

After unloading the compressor end, the engine is started and brought up to a predetermined speed. When minimum engine temperatures are reached, stop valves are operated and the compressor is put on the line.

Normal Speed Control

By remote loading of the engine governor from the control panel, the operator may reset the speed of the engine to meet the demand for gas.

Warning Control

Any abnormal operating temperatures or pressures are reported at the control panel by a signal light and horn. **Emergency Control**

Operating temperatures or pressures which reach emergency conditions are reported at the control panel by a light and horn. At the same time the engine is immediately shut down and all components of the system returned to starting position. Lube oil and cooling water circulate for 10 minutes more before being shut off.

Normal Shutdown Control

Through a series of timed events the engine is slowed down, taken off the line and brought to a stop. At this point all components of the system are returned to the starting position except the lube oil and cooling water systems, which circulate for ten minutes more.

Automatic control panel for I-R gas-engine compressor, designed by Viking Instruments, Inc., in cooperation with Ingersoll-Rand engineers. The panel includes the following instrumentation:



Lube Oil Pressure

Lube Oil Temperature—entering cooler

Lube Oil Temperature—leaving cooler

5 Oil Cooler Water Temperature

Jacket Water Pressure

Jacket Water Temperature—inlet

Jacket Water Temperature—outlet

Manifold Depression

1 Tachometer

Engine Hours

Fuel Gas Pressure

1 Instrument Air, Control Air, Speed Control

"Warning" Signals and Controls

15 "Emergency" Signals and Controls

Start-Stop" Signals and Controls

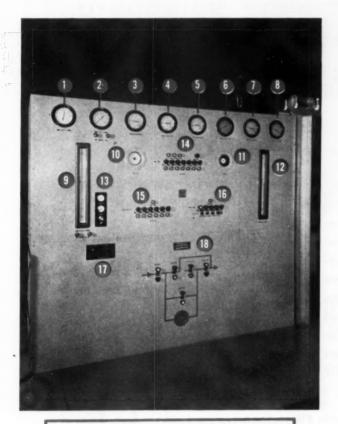
Master Control—Power, Stop, Start, Off

Compressor Valve Indicators and Controls

make gas-engine compressor

"THINK FOR ITSELF"

1320-hp KVG at Hooper Station of Northern Natural Gas Company features Fully-Automatic Sequence Control



Only R compressors have CHANNEL VALVES

Known for high efficiency, quiet operation and exceptional durability. Entirely different. Each valve is a combination of straight-lifting stainless-steel channels and leaf springs, with trapped-air spaces which cushion action, prevent impact.

A touch of a button activates the system which puts this big gas-engine compressor into action—another touch shuts it down. And all the time it's running, automatic instruments control the operation and protect it against damage from any cause.

This Ingersoll-Rand 4-cycle, V-angle KVG gasengine compressor is arranged for completely automatic sequence control operation with a Viking instrument panel. The 1320-hp unit is installed at the Hooper (Nebraska) station of Northern Natural Gas Company.

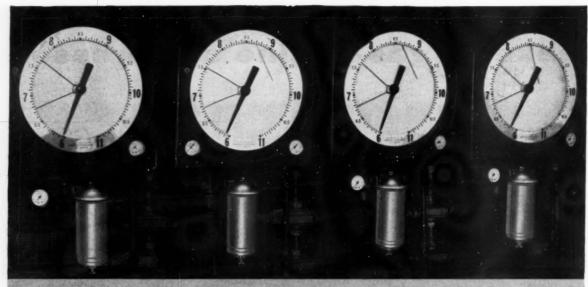
This unit is not only automatic in operation, but is completely self-protecting. Continuous monitoring and alarm facilities permit immediate diagnosis of any trouble at an early stage, so preventive rather than curative measures can be taken—thus down-time and costly repairs are minimized. Should any operating conditions exceed safe limits, the machine is automatically shut down before any damage can be done.

On normal shutdown, the engine is slowed, taken off the line, idled for a minute at no load, and then brought to a stop. After either normal or emergency shutdown, lubricating oil and cooling water are circulated for ten minutes.

Ingersoll-Rand 4-cycle V-angle engine-compressors are ideal for automated and remote-control installations, due to inherently greater operating *stability* through a wide range of speeds and loads. Ingersoll-Rand has supplied millions of horsepower of heavyduty compressors for every possible service, and builds many types of other equipment, in addition to compressors, for the pipeline industry. Call your I-R representative now for more information.

Ingersoll-Rand
11 Broadway, New York 4, N.Y.

COMPRESSORS . GAS & DIESEL ENGINES . AIR & ELECTRIC TOOLS . PUMPS . CONDENSERS . ROCK DRILLS . VACUUM EQUIPMENT



Acme Wire Company safeguards accuracy of air-operated heat controls... with Fulllo Filters

Fulflo Filters, with genuine Honeycomb Filter Tubes, protect these temperature controls at Acme Wire Company, New Haven, Connecticut, by keeping airlines free from microscopic impurities. And that's mighty important—for these instruments control the critical temperatures in the "curing" of enamel insulation. Fulflo Filters minimize gumming—remove moisture, oil, microscopic dust, rust, dirt and scale. By safeguarding accurate operation of these heat controls, Fulflo Filters help assure precise o. d. tolerances for insulation on all Acme magnet wire.

Single-tube Fulflo Filters have 3, 5 or 7-inch Honeycomb Filter Tubes for 10, 30 and 60 cfm at operating pressures up to 125 psi; also for 60 cfm at 250 psi. Hi-Pressure Filter withstands operating pressures up to 4,000 psi. Newest model is a nickel-plated brass Fulflo Filter — sanitary and non-rusting. For high flow rates or central installations, several multi-tube models are available in steel-

and-iron, stainless steel or nickel-plated brass to accommodate pipe sizes of $1\frac{1}{2}$, 2, 3, 4 and 6 inches.



For new catalog on Fulflo Filters for compressed air, CO_2 and other gases, write to Department CA.

COMMERCIAL FILTERS CORPORATION

MELROSE 76, MASSACHUSETTS

PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

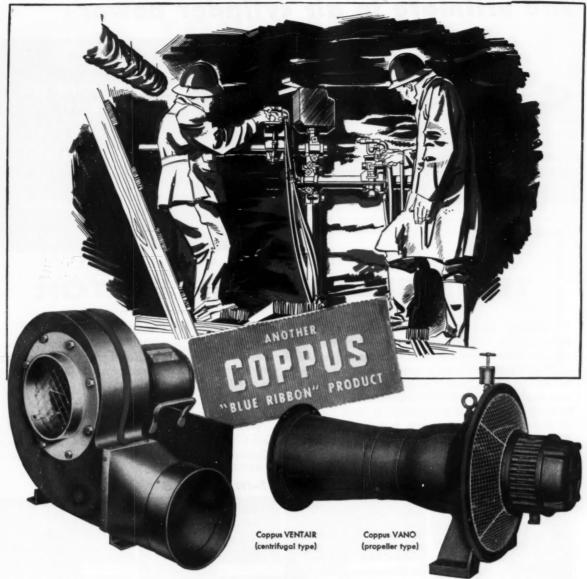
MICRO-CLARITY AT MINIMUM COST



with genuine Honeycomb Filter Tubes for controlled microclarity of industrial fluids.



Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.



Choose between them and get 30% to 100% more air

Coppus Blowers are designed for two different types of mine ventilation requirements: the centrifugal Coppus VENTAIR is for long pipe lines; the propeller-type Coppus VANO for shorter lines . . . the correct selection will give you from ½ more to twice as much air — for a given power consumption — than an ordinary all-purpose fan.

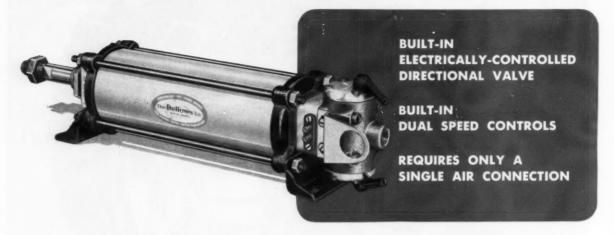
Available for either compressed air or electric motor drive, both can be used as blowers or exhausters and are obtainable in capacities up to 90,000 CFM.

Only Coppus makes both these types, one of which will give you better, more economical mine ventilation . . . know them by the "Blue Ribbon" that symbolizes the engineering and production skill behind every Coppus product.

Representatives listed in MINING CATALOGS. Other Coppus "Blue Ribbon" products: steam turbines, gas burners, heat killers, air filters, blowers and exhausters for special purposes. See also THOMAS' REGISTER... Coppus Engineering Corporation, Worcester 2, Mass.

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Please s	end	Bulletin 130	
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Compan	y	****************************	
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the ultimate in air cylinder power-



THE BELLOWS AIR MOTOR

The Bellows Air Motor is a complete air cylinder power unit, with directional valve and speed controls built-in. Takes less than half the space and costs less installed than a conventional air cylinder set-up of equal power with its separate valving and piping. The single air connection, which can be made with flexible hose, makes it ideal for use on moving machine elements. It is a sturdy unit with forged steel heads, heavy brass cylinder, stainless steel piston rod. The piston rod is

threaded, equipped with a wrench flat and nut. Many Bellows Air Motors have been operating day in and day out for fifteen years with negligible maintenance. And if service needs do arise, there is a Bellows Field engineer as near as your phone. The Bellows Air Motor shown above is a $2\frac{1}{2}$ " bore unit equipped with the Bellows Low-Voltage (8-12V) Electroaire Valve. Other bores available are $1\frac{1}{4}$ ", $1\frac{3}{4}$ ", $3\frac{5}{8}$ " and $4\frac{1}{2}$ ". Any stroke length. Optional choice of built-in valves as shown below.

CHOICE OF BUILT-IN VALVES



115 V. ELECTROAIRE VALVE For J.I.C. applications where a 115 v. momentary contact is desirable.



MECHANICAL VALVE For manual operation or for use with cams or direct linkage.



115 V. MAINTAINED CONTACT
Valve remains in shifted position during period currer* is applied.



AIR-OPERATED

For use in applications calling for full pneumatic control.



Write for these two booklets

Fifty pages of data to help you select the right Air Motor-Valve combination for your job. Address Dept. CA-458. The Bellows Co., Akron 9, Ohio. In Canada: Bellows Pneumatic Devices of Canada, Ltd., Toronto 18. Ask for Bulletins BM-25 and SP-55.

The Bellows Co.

AKRON 9, OHIO

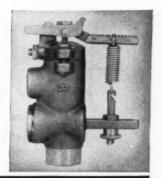
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REBUILT UNLOADER VALVE REPLACEMENT SERVICE

aves ... TIME **PROFITS**



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pumps, this book provides a modern treatment of the whole field. Includes a method of attack

based on: a single pattern of flow; identical theoretical reasoning; and similar design pro-cedure for centrifugal, mixed flow, and axial

flow pumps.

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By A.J. Stepanoff, Ingersoll-Rand Company, Development Engineer Keeps pace with progress...
Revised and expanded to reflect the significant

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New material on centrifugal-jet pump systems Important design elements and performance characteristics incorporated in a single chart covering all important design elements

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QUICK-CONNECTIVE
PUSH-TITE COUPLING



Locking pins in Hansen Push-Tite Coupling Socket afford large area contact with plug, thereby preventing wear and subsequent leakage.

QUICK-CONNECTIVE FLUID LINE COUPLINGS for

AIR • OIL • GREASE
HYDRAULIC FLUIDS • WATER
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SINCE 1915

REPRESENTATIVES IN

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instant automatic flow and shut-off

quick connection and disconnection

> eak-proof minimum wear locking device

integral factory assembled tamper-proof socket head

ONE-WAY SHUT-OFF

• The ability of Hansen Push-Tite Couplings to withstand severe service—with practically no maintenance—has been thoroughly proved by years of hard, everyday use in thousands of plants. The "socket head", which contains the locking device, is factory assembled into a rugged integral unit which cannot be readily injured or have component parts lost by casual tampering.

To connect the Coupling, you merely push the Plug into the Socket with one hand. Flow is instantaneous. To disconnect, push back sleeve on Socket—Coupling disconnects. Flow is shut off instantly and automatically.

WRITE FOR THE HANSEN CATALOG

Here's an always ready reference when you want information on couplings in a hurry. Lists complete range of sizes and types of Hansen Quick-Connective Couplings. Write for your copy.



REPRESENTATIVES IN PRINCIPAL CITIES

QUICK-CONNECTIVE FLUID LINE COUPLINGS

MANUFACTURING COMPANY

4031 WEST 150th STREET

CLEVELAND 35, OHIO

TAMPS 3500 FEET IN 6 HOURS

with two GM Diesel-powered Tie Tampers

The C&O Railroad started using GM Detroit Diesel power in maintenance-of-way equipment in 1947. First engine was in a ditcher. Today the railroad has 28 of these fast-stepping 2-cycle Diesels powering a crane, ditchers, tampers, ballast distributors, dozers, carry-all scrapers and air compressors.

Shown here are two Matisa Tie Tampers, each propelled by a GM "4-71" Diesel which also drives equipment-mounted Ingersoll-Rand compressor to operate tampers. Following ballast distributors to compress ballast under ties for a solid road bed, these two units working together cover up to 3500 feet of road bed in six hours.

The versatile GM Series 71 Diesel offers the same unique features of standardization and parts interchangeability as the "567" locomotive engine. One cylinder assembly fits all units from 2 to 24 cylinders—a single inventory of basic parts protects all engines from 30 to 893 h.p. GM Diesel power is the choice of leading railroads in both on- and off-track equipment because it does more work at less cost! Get full details from your GM Detroit Diesel distributor, or write us.

DETROIT DIESEL

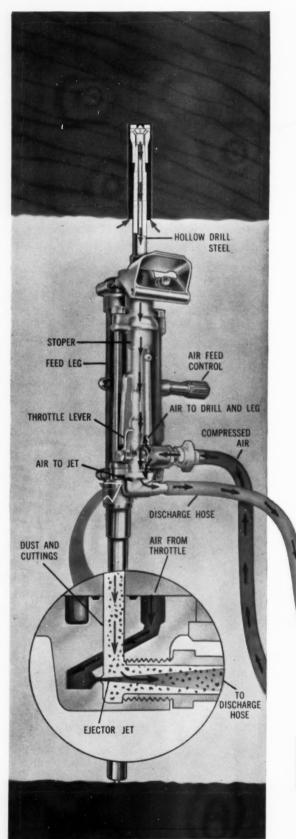
DETROIT DIESEL POWER Engine Division of General Motors Detroit 28, Michigan

REGIONAL OFFICES: New York, Atlanta, Detroit, Chicago, Dallas, San Francisco

Factory Engineered Parts –
Factory Trained Servicemen Everywhere



GM "4-71" Diesels provide power for propulsion and operation of Ingersoll-Rand compressors on Matisa Tie Tampers used by C&O Railroad.



Only the Ingersoll-Rand

VACUJET

DUSTLESS STOPER

offers all these cost-saving advantages

for roof bolting

Designed from the ground up for dry dustless drilling, with built-in jet vacuum and pressure discharge, the Ingersoll-Rand RP38E VACUJET dustless stoper is setting entirely new standards of performance and economy. Here's why:

Strongest Suction Power — vacuum is produced, right in the drill itself — not 25' away. Will even remove cuttings on horizontal holes!

Dust Discharged Under Pressure—no costly vacuum hose required. Ordinary 1" air hose carries dust up to 25 ft. away from drill.

Low-Cost Dust Collector — a simple filter and receptacle is all that's required. Even a canvas bag will do.

Quieter Operation—there is no unnecessary ear-splitting whine or howl in the dust collection system.

Highest Drilling Speed — because stronger suction and ample ports assure non-clogging operation.

Lower Bit-Shop Costs—tapered bit end and plain shanked drill steels eliminate need for furnaces, threading and forging equipment.

There's no other stoper like it!

For complete information, send today for a copy of Bulletin No. 4195.



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